

78-09

STACKS - S.B.T.



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September 1978

# Highway Safety Literature

U.S. Department of Transportation National Highway Traffic Safety Administration

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**GPO:** Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. **Give corporate author, title, personal author, and catalog or stock number.**

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**See publication:** Articles in journals, papers in proceedings, or chapters in books are found in the publication cited. These publications may be in libraries or purchased from publishers or dealers.

**SAE:** Society of Automotive Engineers, Dept. HSL, 400 Commonwealth Drive, Warrendale, Pa. 15096. Order by title and SAE report number.

**TRB:** Transportation Research Board, National Academy of Sciences, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

**Corporate author:** Inquiries should be addressed to the organization listed in the individual citation.

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## **ABSTRACT CITATIONS**

# SAMPLE ENTRIES

## FORMAT OF ENTRIES IN HIGHWAY SAFETY LITERATURE

NHTSA accession number ----- HS-013 124  
Title of document ----- **MAXIMUM BRAKE PEDAL FORCES PRODUCED BY  
MALE AND FEMALE DRIVERS**  
Abstract ----- The object of this research was to obtain data concerning the maximum amount of brake pedal force that automobile drivers were able to sustain over a period of ten seconds. Subjects were told to apply the brakes in the test car as they would in a panic stop, and to exert as much force as possible on the pedal over the entire ten second test period. A total of 84 subjects were tested, including 42 males and 42 females. The results indicated that there is a wide distribution of values which characterizes the pedal force that the subjects were able to generate. Male subjects produced generally higher forces than did females. Over half the women tested were unable to exert more than 150 lbs. of force with either foot alone, but when both feet were applied to the pedal, force levels rose significantly.  
Personal author(s) ----- bv C. R. VonBuseck  
Corporate author (or author's affiliation) ----- General Motors Corp.  
Publication date; pagination ----- 1973? ; 18p  
Supplementary note ----- Excerpts from Maximum Parking Brake Forces Applied by Male and Female Drivers (EM-23) BY R. L. Bierley, 1965, are included.  
Availability ----- Availability: Corporate author

NHTSA accession number ----- HS-018 924  
Title of document ----- **NATURAL FREQUENCIES OF THE BIAS TIRE**  
Abstract ----- The lowest natural frequencies of a bias tire under inflation pressure are deduced by assuming the bias tire as a composite structure of a bias-laminated, toroidal membrane shell and rigorously taking three displacement components into consideration. The point collocation method is used to solve a derived system of differential equations with variable coefficients. It is found that the lowest natural frequencies calculated for two kinds of bias tire agree well with the corresponding experimental results in a wide range of inflation pressures. Results of the approximate analysis show that the influences of the in-plane inertia forces on natural frequency may be considered small, but the influences of in-plane displacements are large, particularly on the natural frequency of the tire under low inflation pressure.  
Personal author(s) ----- by Masami Hirano; Takashi Akasaka  
Journal citation ----- Publ: Tire Science and Technology v4 n2 p86-114 (May 1976)  
Publication date ----- 1976; 6refs  
Availability ----- Availability: See publication



HS-022 283

### **SAFETY CONSIDERATIONS FOR A DEMONSTRATION PROGRAM OF ELECTRIC VEHICLES. TASK FINAL REPORT**

USING EXISTING SMALL CARS AS SURROGATES, IT IS ESTIMATED THAT THE PROBABILITY OF LESS THAN TEN INJURIES IN A YEAR OF OPERATING 2500 ELECTRIC VEHICLES IN AN ENVIRONMENT OF PRESENT HIGHWAY TRAFFIC CONDITIONS, WHETHER URBAN OR NOT, IS ESSENTIALLY ZERO, BUT THAT THE PROBABILITY OF MORE THAN 50 INJURIES FOR URBAN OPERATION IS ALSO QUITE SMALL. THE EXPECTED NUMBER OF FATALITIES HAS BEEN COMPUTED FOR SMALL CARS WITHOUT COMPLIANCE WITH EXISTING SAFETY STANDARDS, AND ALSO FOR THOSE WITH SUCH COMPLIANCE. IN BOTH CASES THE EXPECTED NUMBER IS LESS THAN ONE, I.E. IT IS RATHER LIKELY THAT NO FATALITIES WILL OCCUR. ALTHOUGH THERE ARE MODERATE EXPECTED DIFFERENCES IN CASUALTY RATES BETWEEN PRESTANDARD AND POSTSTANDARD VEHICLES, THE PRACTICAL SIGNIFICANCE OF THESE DIFFERENCES SEEMS TO BE NEGLIGIBLE. PARTICULARLY FOR THE FIRST TRIAL FLEET OF 2500 VEHICLES, THE IMPOSITION OF STRINGENT SAFETY STANDARDS WOULD HAVE ONLY A MARGINAL SAFETY VALUE, AND IT MIGHT IMPEDE ATTAINMENT OF THE STATED GOALS OF THE PROGRAM BY DELAYING PRODUCTION, LIMITING THE RANGE OF VEHICLES AVAILABLE FOR TEST, AND ADDING WEIGHT TO THE VEHICLES, WHICH WOULD REDUCE PERFORMANCE. THE LIKELY SAFETY SHORTCOMINGS OF PROSPECTIVE CARS SHOULD, HOWEVER, BE PLANNED FOR AND UNDERSTOOD.

by JAMES O'DAY; LILY HUANG  
UNIVERSITY OF MICHIGAN, HWY. SAFETY RES.  
INST., ANN ARBOR, MICH. 48109  
Rept. No. UM-HSRI-77-45; 1977; 39P 6REFS  
REPT. FOR JUL-AUG 1977.  
Availability: CORPORATE AUTHOR

HS-022 705

### **SPEED LIMITS AND ENFORCEMENT**

A DISCUSSION IS PRESENTED OF THE EFFECT OF POLICE SUPERVISION ON THE ENFORCEMENT OF SPEED LIMITS. THE BACKGROUND OF SPEED LIMIT LEGISLATION IN THE NETHERLANDS AND THE U.S. IS SKETCHED. CRITERIA FOR ROAD BEHAVIOR REGULATION ARE GIVEN; OFFENSES AS CAUSES AND AS ACCIDENT PREDICTORS ARE CONSIDERED; ASPECTS OF SPEED LIMIT PERCEPTION, ATTITUDES TO SPEED LIMITS AND ROAD USERS' SPEED HABITS ANALYZED. THE EFFECT OF CHANCES OF DETECTION IS EVALUATED, AND THE PREVENTIVE, REDRESSIVE, AND REPRESSIVE EFFECTS OF ENFORCEMENT, WITH THE TYPES OF ENFORCEMENT AVAILABLE. SOME STATISTICAL RESULTS OF INCREASED ENFORCEMENT ARE GIVEN. THE SECOND REPORT SETS OUT A FRAMEWORK OF CONCEPTS BASED ON THE CHANCE OF DETECTION WITHIN

WHICH A FURTHER STUDY IS TO BE DEVELOPED. THE OBJECTIVE AND SUBJECTIVE ASPECTS OF BOTH THE COLLECTIVE AND INDIVIDUAL RISK OF DETECTION ARE DISCUSSED, WITH RELATION TO CONSIDERATIONS OF SAFETY AND TO THE PENALTY IN THE EVENT OF OFFENSE. WAYS AND MEANS OF INFLUENCING TRAFFIC BEHAVIOR, AND EXPECTED RESULTS OF ENFORCEMENT, ARE DESCRIBED.

INSTITUTE FOR ROAD SAFETY RES. SWOV, P.O. BOX  
71, DEERNSSTRAAT 1, VOORBURG 2119,  
NETHERLANDS  
Rept. No. PUB-1973-2E; 1973; 28P REFS  
INCLUDES HS-022 706 AND HS-022 707.  
Availability: CORPORATE AUTHOR

HS-022 706

### **SPEED LIMITS AND ENFORCEMENT BY POLICE SUPERVISION**

STATISTICS ARE INADEQUATE FOR EXAMINING THE REAL INFLUENCE OF ROAD AND TRAFFIC OFFENSES ON ROAD SAFETY, AND LITTLE CORRELATION APPEARS BETWEEN OFFENSES AND ACCIDENT PREDICTION. CRITERIA FOR REGULATIONS CONCERNING ROAD BEHAVIOR SHOULD GIVE INFORMATION AND PERMIT CLEAR INTERPRETATION, SHOULD BE NON-CONTRADICTORY, POSSESS VALIDITY AND SIGNIFICANCE IN SAFE TRAFFIC CONTROL, BE CAPABLE OF BEING OBEYED BY ROAD USERS AND ENFORCEABLE BY THE POLICE. THE BACKGROUND OF SPEED LIMIT LEGISLATION IN NETHERLANDS AND THE U.S. IS SKETCHED. CHARACTERISTICS OF ROAD BEHAVIOR INCLUDE SPEED LIMIT PERCEPTION, ROAD USERS' SPEED HABITS, AND ATTITUDES TO SPEED LIMITS. THE CHANCE OF SANCTIONS FOR INDIVIDUAL ROAD USERS CONSISTS OF THE CHANCES OF BEING STOPPED FOR BREAKING SPEED LIMITS, OF PROSECUTION AFTER BEING STOPPED, AND OF A PENALTY AFTER PROSECUTION. IF THE SUBJECTIVE EVALUATION OF THESE FACTORS IS VERY LOW, MEASURES AIMED AT CHANGING THE OBJECTIVE FACTS WILL HAVE MORE EFFECT ON SUBJECTIVE EVALUATION UNTIL THE OPTIMUM SITUATION IS REACHED. EFFECTS OF ENFORCEMENT MAY BE PREVENTIVE, INFLUENCING BEHAVIOR TO AVOID CERTAIN OFFENSES; REDRESSIVE, CAUSING A BEHAVIOR CHANGE ON THE SPOT, USUALLY NOT LASTING; AND REPRESSIVE, RELATING TO THE CONSEQUENCES OF THE INDIVIDUAL SANCTION, PROSECUTION. NOTICEABLE ENFORCEMENT, CARRIED OUT WITH MOVING OR STATIONARY POLICE CARS WITH VISIBLE MEASURING DEVICES, IS MORE EFFECTIVE ON ROAD BEHAVIOR THAN INCONSPICUOUS ENFORCEMENT. CONCLUSIONS STRESS THE LACK OF ADEQUATE KNOWLEDGE ABOUT EFFECTS OF SPEED LIMIT ENFORCEMENT, THE NEED FOR INCREASED POLICE FORCES TO PROVIDE NOTICEABLE ENFORCEMENT, THE CORRECT LOCATION OF TRAFFIC SIGNS, AND THE IMPORTANCE OF

IMPRESSING THE ROAD USER WITH THE DANGER OF SPEEDING AND OF BEING DETECTED.

by J. H. KRAAY; P. C. MATTIE  
INSTITUTE FOR ROAD SAFETY RES. SWOV, OECD  
RES. GROUP S6, P.O. BOX 71, DEERNSSTRAAT 1,  
VOORBURG 2119, NETHERLANDS  
Publ: HS-022 705, "SPEED LIMITS AND  
ENFORCEMENT," VOORBURG, 1973 P7-21  
1973; 25REFS  
PREPARED FOR OECD RES. GROUP S6: THE EFFECTS  
OF THE ENFORCEMENT OF LEGISLATION ON ROAD  
USER BEHAVIOR AND TRAFFIC ACCIDENTS.  
Availability: IN HS-022 705

HS-022 707

### OBJECTIVE AND SUBJECTIVE RISK OF DETECTION

POLICE ENFORCEMENT PRODUCES THREE EFFECTS: PREVENTIVE, MODIFYING BEHAVIOR OF ROAD USERS TO PROVIDE A SAFE AND EFFICIENT TRAFFIC SYSTEM; REDRESSIVE, RELATING TO THE IMMEDIATE, ON-THE-SPOT CHANGE IN CONDUCT OF THE ROAD USER BECAUSE OF THE CONSPICUOUSNESS OF SUPERVISION (USUALLY A TEMPORARY EFFECT); AND REPRESSIVE, RELATING TO THE PUNISHMENT OF THE OFFENDER. COLLECTIVE AND INDIVIDUAL RISKS OF DETECTION ARE COMPARED, WITH THEIR OBJECTIVE AND SUBJECTIVE ASPECTS; THE SUBJECTIVE EVALUATION OF THE INDIVIDUAL RISK OF DETECTION, CONVEYING MORE TO THE INDIVIDUAL ROAD USER, WILL GOVERN HIS ULTIMATE ACTION. CONSIDERATIONS ENTERING INTO HIS EVALUATION ARE THOSE OF SAFETY AND THOSE RELATING TO THE PENALTY IN THE EVENT OF OFFENSE. VISIBILITY, CONSPICUOUSNESS, AND RECOGNIZABILITY OF TRAFFIC SIGNS ARE RELEVANT TO THE DRIVER'S PERCEPTION. FUNDAMENTAL RESEARCH IS NECESSARY IN ASCERTAINING IN WHAT AREAS THE ROAD USER CAN BE MOST EFFECTIVELY INFLUENCED; INCREASING THE OBJECTIVE INDIVIDUAL RISK WOULD BE MOST INFLUENTIAL. WITH PROPER ENFORCEMENT, REDRESSIVE EFFECTS SHOULD BE INCREASINGLY REPLACED BY PREVENTIVE EFFECTS.

by J. H. KRAAY  
INSTITUTE FOR ROAD SAFETY RES. SWOV, OECD  
RES. GROUP S6, P.O. BOX 71, DEERNSSTRAAT 1,  
VOORBURG 2119, NETHERLANDS  
Publ: HS-022 705, "SPEED LIMITS AND  
ENFORCEMENT," VOORBURG, 1973 P23-30  
1973  
PREPARED FOR OECD RES. GROUP S6: THE EFFECTS  
OF THE ENFORCEMENT OF LEGISLATION ON ROAD  
USER BEHAVIOR AND TRAFFIC ACCIDENTS.  
Availability: IN HS-022 705

HS-022 708

### RECOMMENDED PROCEDURES FOR VEHICLE CRASH TESTING OF HIGHWAY APPURTENANCES

THE ENTIRE NCHRP REPORT 153 IS PRESENTED WITH MATERIAL TO BE DELETED LINED OUT AND NEW MATERIAL ENTERED IN DIFFERENT TYPE. RECOMMENDED PROCEDURES DEAL WITH TESTING AND

EVALUATING THE SAFETY OF ROADSIDE APPURTENANCES BY CRASHING PASSENGER VEHICLE INTO THEM. SAFETY PERFORMANCE OF THE TEST ARTICLE IS PRIMARILY EVALUATED ACCORDING TO THE DEGREE OF HAZARD THAT OCCUPANTS OF THE IMPACTING VEHICLE WOULD BE SUBJECTED TO AND THE PROBABLE INVOLVEMENT OF OTHER NEARBY TRAFFIC. QUALIFICATIONS FOR THE TESTING FACILITY, THE TEST ARTICLE, TEST VEHICLE AND TEST CONDITIONS ARE DESCRIBED, WITH THE DATA ACQUISITION SYSTEMS, PERFORMANCE EVALUATION AND FINAL REPORT. A COMMENTARY FOLLOWS, DEALING MORE SPECIFICALLY WITH EACH OF THESE HEADINGS. ADDITIONS TO SECTIONS OF THE COMMENTARY PERTAIN TO THE WEIGHT OF PASSENGER VEHICLES TO BE TESTED TO PERMANENTLY INSTALLED HIGHWAY APPURTENANCES, TO THE ENSURING OF REALISTIC SITUATION CONDITIONS, TO PROVIDING COMPREHENSIVE DESCRIPTION DATA FOR SPECIAL TESTS OF VARIOUS APPURTENANCES, TO INCREASE OF CAPABILITY IN RECORDING THE SIX BASIC ACCELERATIONS OF THE VEHICLE AND USING HIGH-SPEED FILM RESTRAINT OF ANTHROPOMORPHIC DUMMIES IN TESTING IS DISCUSSED IN GREATER DETAIL IN THE AMENDED VERSION. VEHICLE DAMAGE SCALES SPECIFIED ARE TRAFFIC ACCIDENT SCALE AND VEHICLE DAMAGE INDEX. A SUGGESTED TEST/ACCEPTANCE EVALUATION SEQUENCE FOR BREAKAWAY SUPPORTS IS PRESENTED.

NATIONAL ACAD. OF SCIENCES, TRANSPORTATION  
RES. BOARD, 2101 CONSTITUTION AVE.,  
WASHINGTON, D.C. 20418  
Rept. No. CIRC-191; 1978; 27P 22REFS  
Availability: CORPORATE AUTHOR

HS-022 709

### OCCUPANT RESTRAINTS IN MOTOR VEHICLES--THE PRESENT SITUATION

THE SIGNIFICANT BENEFITS IN TERMS OF REDUCTIONS OF CASUALTIES FOLLOWING INTRODUCTION IN AUSTRALIA OF LEGISLATION ENFORCING THE WEARING OF SEAT BELTS, HIGHLIGHT THE NEED FOR COMPULSORY RESTRAINTS FOR CHILDREN. SURVEYS IN 1975 AND 1976 PROVIDE INFORMATION ON THE AVAILABILITY OF RESTRAINTS TO ALL CHILDREN, THE WEARING OF RESTRAINTS AND THE ATTITUDE OF CHILDREN (SEATED, STANDING, LYING ON SEAT, NURSED, ETC.). RESULTS, SUPPORTED WHEN POSSIBLE BY A NATIONAL ROADS AND MOTORISTS' ASSOC. SURVEY, ARE USED TO DESCRIBE THE RESTRAINT OF CHILDREN IN CARS. OVERALL, IN MELBOURNE AND CANBERRA (AUSTRALIA) APPROXIMATELY EVERY THREE OUT OF FOUR CAR OCCUPANTS AT LEAST EIGHT YEARS OLD WITH A SEAT BELT AVAILABLE USE IT. FITTING OF SEAT BELTS IS MANDATORY UPON MANUFACTURE, BUT PROVISION OF A SUITABLE RESTRAINT FOR A CHILD IS LEFT TO THE PARENT OR VEHICLE OWNER. MANUFACTURERS MUST NOW PROVIDE UPPER ANCHORAGE POINTS IN EACH REAR SEATING POSITION OF CARS TO FACILITATE FITTING OF CHILD RESTRAINTS. LOCATION WITHIN THE CAR IS IMPORTANT; SAFEST CHILDREN ARE THOSE IN REAR

SEATING POSITIONS AND RESTRAINED, WITH LITTLE DIFFERENCE BETWEEN RESTRAINED CHILDREN IN FRONT SEAT AND UNRESTRAINED IN REAR SEAT. THE FORM OF LEGISLATION MOST SUCCESSFUL IN REDUCING CASUALTIES HAS BEEN THAT IN WHICH, IF A SUITABLE RESTRAINT IS AVAILABLE IN THE CAR IT MUST BE WORN, AND NO CHILD IS ALLOWED TO TRAVEL UNRESTRAINED IN THE FRONT SEAT IF A REAR SEAT POSITION IS AVAILABLE. FURTHER IMPROVEMENT COULD BE ACHIEVED BY LEGISLATION TO PROHIBIT BOTH THE SALE AND PLACEMENT IN CARS OF UNAPPROVED CHILD RESTRAINTS, AND PROHIBITING BOTH THE NURSING OF CHILDREN AND STANDING OF CHILDREN IN FRONT SEATS, BY ENCOURAGING PURCHASE AND USE OF APPROVED CHILD RESTRAINTS AND OF SEAT BELTS BY THOSE AT LEAST FIVE YEARS OLD WHEN NO MORE SUITABLE RESTRAINT IS AVAILABLE.

by C. J. BOUGHTON  
COMMONWEALTH DEPT. OF TRANSPORT, ROAD  
SAFETY INFORMATION SERVICE, AUSTRALIA  
1978?; 21P 15REFS  
Availability: REFERENCE COPY ONLY

HS-022 710

**MODELING VISION WITH HEADLIGHTS IN A SYSTEMS CONTEXT**

A HEADLAMP EVALUATION MODEL WAS DEVELOPED WHICH ACCEPTS AS INPUT THE CANDLEPOWER PATTERNS OF THE HEADLAMP SYSTEM BEING EVALUATED AND PROVIDES A MEASURE OF DRIVER VISUAL PERFORMANCE BASED ON A LARGE NUMBER OF SIMULATED SEEING DISTANCE TESTS AND GLARE DISCOMFORT CHECKS ON A STANDARDIZED TEST ROUTE. OUTPUT OF THE MODEL, TERMED THE FIGURE OF MERIT, IS THE PERCENTAGE OF THE DISTANCE TRAVELED BY THE SIMULATED DRIVER ON THE TEST ROUTE IN WHICH THE SEEING DISTANCE TO PEDESTRIANS AND PAVEMENT LINES AND THE DISCOMFORT GLARE LEVELS EXPERIENCED BY OPPOSING DRIVERS SIMULTANEOUSLY MEET CERTAIN ACCEPTANCE CRITERIA. THE TEST ROUTE IS A COMPUTER REPRESENTATION OF A SERIES OF HIGHWAY SECTIONS IN THE FORM OF A FILE OF ENVIRONMENTAL PARAMETERS WHICH INFLUENCE VISUAL PERFORMANCE IN NIGHT DRIVING. PAVEMENT, LANE LINE, AND PEDESTRIAN REFLECTANCE ARE INCLUDED, WITH ROAD GEOMETRY, LANE CONFIGURATION, AMBIENT ILLUMINATION AND GLARE FROM FIXED LIGHTING, AND TRAFFIC AND PEDESTRIAN DENSITY. THE STANDARDIZED TEST ROUTE IS A REPRESENTATION OF A U.S. NIGHT DRIVING ENVIRONMENT AS MEASURED IN A SERIES OF FIELD SURVEYS COVERING THOUSANDS OF MILES OF HIGHWAY AND AS REPORTED IN THE LITERATURE. SEEING DISTANCE CALCULATIONS ARE PERFORMED BY AN INTEGRAL SEEING DISTANCE MODEL BASED ON THE HUMAN VISUAL PERFORMANCE LITERATURE AND VALIDATED BY FIELD STUDIES. RESPONSE TO GLARE IS BASED ON PUBLISHED DISCOMFORT GLARE FORMULATIONS, MODIFIED AND VALIDATED ON THE BASIS OF HIGHWAY TESTS. BECAUSE DRIVER VISUAL PERFORMANCE, AS EXPRESSED IN

THE FIGURE OF MERIT, IS FUNCTIONALLY DEPENDENT ON ENVIRONMENTAL FACTORS AS WELL AS ON HEADLAMP CHARACTERISTICS, THE FIGURE OF MERIT IS A SYSTEMS MEASURE. THE MODEL CAN BE USED NOT ONLY TO EVALUATE HEADLAMPS BUT TO MEASURE SENSITIVITY OF DRIVER VISUAL PERFORMANCE TO ENVIRONMENTAL FACTORS AND THUS TO IMPROVEMENTS IN CERTAIN ASPECTS OF THE HIGHWAY ITSELF. APPLICATIONS OF THE MODEL SHOW THAT DRIVER VISUAL PERFORMANCE AT NIGHT IS MORE SENSITIVE TO ENVIRONMENTAL CONDITIONS AND TO THE DRIVER'S VISUAL CAPABILITIES THAN TO THE RANGE OF CHARACTERISTICS EXHIBITED BY EXISTING AND PROPOSED HEADLIGHT SYSTEMS. OTHER APPLICATIONS INCLUDE A COMPARISON OF SEVERAL EUROPEAN AND MIDBEAM SYSTEMS WITH CURRENT U.S. SYSTEMS, EVALUATION OF HEADLAMP MISAIM EFFECTS, AND A DETERMINATION OF THE EFFECTIVENESS OF IMPROVING THE BRIGHTNESS OF PAVEMENT LINES.

by VIVEK D. BHISE; EUGENE I. FARBER; CAROL S. SAUNBY; GEORGE M. TROELL; JAMES B. WALUNAS; ARTHUR BERNSTEIN  
FORD MOTOR CO., AUTOMOTIVE SAFETY OFFICE,  
P.O. BOX 2053, DEARBORN, MICH. 48121  
Rept. No. SAE-770238; 1977; 64P 39REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 712

**STUDY OF THE EFFECT OF USAGE ON SEAT BELT STRENGTH**

A TESTING PROGRAM WAS CARRIED OUT ON USED SEAT BELTS, INCLUDING BELTS WORN IN FRONTAL ACCIDENTS, TO ASSESS THE EFFECT OF USAGE ON PERFORMANCE OF THE SEATBELT ASSEMBLY. ALTHOUGH INSUFFICIENT BELTS WERE TESTED FROM EITHER THE USED SEAT BELT OR THE ACCIDENT BELT GROUPS TO ARRIVE AT POSITIVE CONCLUSIONS, CERTAIN FINDINGS WERE MADE. OF THE NONACCIDENT BELTS, THERE APPEARED TO BE NO CORRELATION BETWEEN VISUAL CLASSIFICATION AND FAILURE, E.G. OF THOSE CLASSIFIED AS GOOD, 9 PASSED AND 12 FAILED; NO CORRELATION BETWEEN FAILURE AND USE IN DUSTY CONDITIONS; NONE BETWEEN FAILURE AND USAGE OF BELT, E.G. FROM THE SAME VEHICLE THE PASSENGER'S BELT WHICH WAS USED SIX TIMES A WEEK FAILED AND THE DRIVER'S BELT, USED 55 TIMES A WEEK, PASSED. A LACK OF QUALITY CONTROL, OR POOR DESIGN, OR BOTH, WAS SUGGESTED BY RESULTS. OF THE ACCIDENT BELTS TESTED, 50% FAILED REQUIREMENTS OF AUSTRALIAN STANDARD (AS) E35. A SIGNIFICANT PERCENTAGE OF THESE FAILURES WAS NOT CONTRIBUTED TO BY THE ACCIDENT; THE BELTS WOULD HAVE FAILED IN ANY CASE. NO CORRELATION COULD BE ESTABLISHED BETWEEN FAILURES AND THE SEVERITY OF THE COLLISION AS INDICATED BY THE ASSESSED REPAIR COST. AT LEAST ONE MORE TEST PROGRAM IS RECOMMENDED, WITH 100 SEAT BELTS EACH FROM FOUR OF THE MAJOR MANUFAC-

TURERS. STRONG EMPHASIS ON CHECKING QUALITY CONTROL BY THE MANUFACTURERS IS URGED. AS EVIDENCE WAS FOUND OF MISUSE OF SEAT BELTS, A SURVEY IS RECOMMENDED ON USAGE OF BELTS. IN FUTURE TESTS OF SEAT BELTS WORN IN ACCIDENTS, A SECOND BELT, NOT WORN, FROM THE SAME VEHICLE SHOULD ALSO BE TESTED. TESTING OF NEW BELTS, PURCHASED FROM VARIOUS LOCATIONS, IS ALSO SUGGESTED. A GLOSSARY AND EXTENSIVE TEST DATA SHEETS ARE APPENDED.

SNOWY MOUNTAINS ENGINEERING CORP.,  
AUSTRALIA  
Rept. No. DOC-5076/77; 1976; 215P  
PROJECT COMMISSIONED BY AUSTRALIAN DEPT. OF  
TRANSPORT.  
Availability: REFERENCE COPY ONLY

HS-022 713

### **THE EFFECTIVENESS OF SEAT BELT LEGISLATION IN REDUCING ROAD ACCIDENT CASUALTIES IN AUSTRALIA**

IN EACH OF THE SIX YEARS FOLLOWING COMPULSORY SEATBELT WEARING LEGISLATION IN THE AUSTRALIAN STATES AND TERRITORIES, THE NUMBER OF TRAFFIC ACCIDENT DEATHS FOR AUSTRALIA AS A WHOLE HAS BEEN CONTAINED BELOW THE RECORD LEVEL OF 3798 IN 1970, DESPITE INCREASES OF 1 MILLION IN POPULATION AND 2 MILLION IN NUMBER OF MOTOR VEHICLES. STUDIES ASSESSING THE EFFECTIVENESS OF SEATBELT WEARING ARE REVIEWED, INFORMATION PROVIDED ON RELEVANT AUSTRALIAN VEHICLE SAFETY STANDARDS, AND EFFORTS TO IMPROVE PROTECTION OF CHILDREN DISCUSSED. SUCCESS OF THE PROGRAM IS ASCRIBED TO THE EXISTENCE OF SIGNIFICANT NUMBERS OF SUITABLE BELTS IN CARS, FAVORABLE COMMUNITY ATTITUDE, AND WILLINGNESS OF LEGISLATORS TO IMPLEMENT LEGISLATION IN SPITE OF OPPOSITION. BELT WEARING RATES AND BELT PERFORMANCE IN CRASHES SHOULD BE UNDER CONTINUOUS REVIEW.

by J. H. W. PERMEZEL  
1977; 22P 33REFS  
PRESENTED TO THIRD AUTOMOTIVE ENGINEERING  
CONFERENCE, TOKYO-SAEJ, 7-9 NOV 1977.  
Availability: REFERENCE COPY ONLY

HS-022 714

### **ROAD SAFETY ANNUAL REPORT 1977 (RAPPORT ANNUEL 1977 SECURITE ROUTIERE)**

THIS SEVENTH ANNUAL REPORT OUTLINES THE ROLE OF THE BRANCH AND DETAILS ITS PROGRAMS FOR THE BETTERMENT OF MOTOR VEHICLE SAFETY IN CANADA. WHILE ROAD SAFETY IS PRIMARILY A PROVINCIAL RESPONSIBILITY, THE DEPT. COMPLEMENTS ITS PROGRAMS BY ESTABLISHING STANDARDS FOR NEW AND IMPORTED MOTOR VEHICLES AND THEIR COMPONENTS, AS WELL AS RESEARCHING THE ROAD SAFETY PROBLEM AS A TOTAL SYSTEM. A REVERSAL OF FATALITY RATES IN 1975 IS THE FIRST DOWNWARD TREND IN MOTOR

ACCIDENT FATALITIES EVER RECORDED IN CANADA, ESPECIALLY ENCOURAGING IN VIEW OF THE INCREASE IN NUMBER OF VEHICLES IN USE AND IN AMOUNT OF TRAVEL. ORGANIZATION OF THE TRAFFIC SAFETY BRANCH INTO FOUR PROGRAM AREAS SUPPORTED BY AN ADMINISTRATIVE DIV. IS EXPLAINED: COUNTERMEASURE DEVELOPMENT, MOTOR VEHICLE AND RD. SAFETY PROGRAMS, AND MOTOR VEHICLE TEST CENTER, WITH A DETAILED EVALUATION OF THE WORK OF EACH AREA. AMONG CURRENT SAFETY ISSUES CONSIDERED MOST PRESSING ARE INCREASING THE COMFORT AND EFFECTIVENESS OF SEAT BELTS AND INVESTIGATING THE ROLE OF AIR BAGS. DRAFTING SCHOOL BUS SAFETY STANDARDS, DETERMINING THE FINAL AIR-BRAKE STANDARDS FOR TRUCKS AND BUSES FOLLOWING ACCIDENT AND EQUIPMENT STUDIES, ENSURING THAT LIGHTER CARS RESULTING FROM FUEL ECONOMY GOALS MAINTAIN A HIGH LEVEL OF SAFETY, AND WORKING WITH THE U.S., JAPAN, AND EUROPEAN COUNTRIES TO HARMONIZE TEST METHODS AND PROCEDURES. FURTHER PROGRAMS AND COUNTERMEASURE DEVELOPMENT STUDIES ARE DESCRIBED. APPENDICES INCLUDE THE ORGANIZATION OF THE BRANCH, A LIST OF NEGOTIATED CONTRACTS CANADA MOTOR VEHICLE SAFETY STANDARDS, MOTOR VEHICLE SAFETY DEFECT RECALL CAMPAIGNS, DISTRIBUTION BY PROBLEM OF FORMAL PUBLIC REPRESENTATIONS ANALYZED, DETAILS OF COMPANY CONTACTS AND AUDIT INSPECTIONS, DETAILS OF MOTOR VEHICLE TEST PROGRAMS, LIST OF LABORATORIES TESTING, PROPOSED AMENDMENTS TO STANDARDS, PUBLISHED AMENDMENTS TO STANDARDS, AND DATA ON TRANSPORTATION FATALITIES.

CANADIAN MINISTRY OF TRANSPORT, ROAD AND  
MOTOR VEHICLE TRAFFIC SAFETY BRANCH,  
OTTAWA, ONT., CANADA  
Rept. No. TP-455; CTS-1-77; 1977; 97P  
TEXT ALSO IN FRENCH.  
Availability: CORPORATE AUTHOR

HS-022 715

### **THE INFLUENCE OF MOTORCYCLE VISIBILITY ON TRAFFIC ACCIDENTS**

A LITERATURE REVIEW SHOWS THAT INADEQUATE MOTORCYCLE VISIBILITY IS CONSIDERED TO BE AN IMPORTANT FACTOR IN MOTORCYCLE ACCIDENTS; A STUDY OF CASUALTY MOTORCYCLE ACCIDENTS OCCURRING IN VICTORIA DURING 1974 WAS CARRIED OUT. IT WAS ESTIMATED THAT A MINIMUM OF 21% OF MOTORCYCLE MULTIVEHICLE DAYTIME ACCIDENTS HAD LACK OF VISIBILITY AS A CAUSATIVE FACTOR, MOST OF THESE IN SITUATIONS WHERE A MOTORCAR DRIVER WOULD HAVE HAD CLOSE TO A FRONTAL VIEW OF THE MOTORCYCLE. OBSTRUCTION OF VISION BY OTHER VEHICLES OR ROAD CONDITIONS, CONCENTRATION ON ANOTHER VEHICLE, UNDERESTIMATION OF SPEED, OR ABERRANT DRIVING ARE LISTED AS POSSIBLE CAUSES, BUT ASSESSMENT OF THE PROBLEM IN TERMS OF THE PHYSIOLOGY OF HUMAN VISION ALONE IS INADEQUATE; THE COMPARATIVE RARITY OF MOTOR-

CYCLES IN MIXED TRAFFIC MAY BE MORE RELEVANT. DEVICES FOR INCREASING DAYTIME MOTORCYCLE VISIBILITY ARE REVIEWED AND FOUR OF THESE (HIGH AND LOW BEAM HEADLIGHTS, WHITE WIND FAIRING, AND A RED FLUORESCENT RIDER'S JACKET) WERE EXPERIMENTALLY EVALUATED. LABORATORY EXPERIMENTS INDICATE THAT THE HIGH BEAM HEADLIGHT IS SIGNIFICANTLY BETTER THAN THE OTHER DEVICES FOR IMPROVING THE DAYTIME DETECTABILITY OF THE MOTORCYCLE, BOTH IN LIGHT AND DENSE TRAFFIC CONDITIONS; IN ORDER OF DETECTABILITY: HIGH BEAM HEADLAMP, LOW BEAM HEADLAMP, WHITE WIND FAIRING, AND RED FLUORESCENT JACKET. COMBINATIONS OF DEVICES WERE NOT TESTED. FURTHER DETAILED STUDY IS RECOMMENDED.

by MARTIN J. WILLIAMS; ERROL R. HOFFMANN  
UNIVERSITY OF MELBOURNE, DEPT. OF  
MECHANICAL ENGINEERING, AUSTRALIA  
1977; 181P 58REFS  
SPONSORED BY COMMONWEALTH DEPT. OF  
TRANSPORT, AUSTRALIA.  
Availability: CORPORATE AUTHOR

HS-022 716

#### **VALIDATION STUDY OF A THREE-DIMENSIONAL CRASH VICTIM SIMULATOR FOR PEDESTRIAN-VEHICLE IMPACT**

A VALIDATION STUDY WAS CONDUCTED OF CALSPAN CORP.'S CRASH VICTIM SIMULATOR (CAL3-D CVS), A THREE-DIMENSIONAL MATHEMATICAL MODEL FOR THE SIMULATION OF A CRASH VICTIM IN A VEHICULAR IMPACT. DATA WERE GATHERED USING A 95% MALE ANTHROPOMETRIC DUMMY AND UNEMBALMED CADAVERS FOR THE SIMULATION OF PEDESTRIAN IMPACT AGAINST THE FRONT END OF A 1973 CHEVROLET AND WERE USED FOR VALIDATION OF THE CAL3-D CVS. DATA ACQUIRED DURING DROP TESTS ON THE SAME 95% MALE DUMMY ONTO A MOCK-UP OF THE FRONT END OF AN AUTOMOBILE WERE ALSO USED. IT WAS CONCLUDED THAT THE CAL3-D GROSS MOTION SIMULATOR IS CAPABLE OF SIMULATING VEHICLE PEDESTRIAN IMPACT. THE CORRELATION IS GOOD CONSIDERING THE COMPLEXITY OF THE IMPACT EVENT. THE VALIDATION ATTEMPT WAS MADE WITHOUT ANY ADJUSTMENTS TO THE INPUT DATA, MOST OF WHICH WERE MEASURED. THOSE THAT WERE ASSUMED WERE BASED ON PREVIOUS USAGE OR MEASUREMENTS MADE BY OTHER INVESTIGATORS. THE CORRELATION SEEMS TO BE FREQUENCY DEPENDENT. THE MODEL OUTPUT FORMAT IS CONVENIENT TO USE AND THE SPECIAL FEATURES IN THE MODEL FACILITATED THE SIMULATION OF THIS IMPACT EVENT. BY EXPRESSING ACCELERATIONS IN TERMS OF THE SEGMENT-FIXED REFERENCE FRAME AND DISPLACEMENTS RELATIVE TO THE VEHICLE-FIXED FRAME, A COMPARISON OF EXPERIMENTAL AND MODEL KINEMATICS COULD BE MADE DIRECTLY. THE DISJOINTED SEGMENT OPTION WAS EXTREMELY HELPFUL IN CONSTITUTING THE FRONT-END GEOMETRY OF THE IMPACTING VEHICLE. FROM THE POINT OF VIEW OF FUTURE IMPROVEMENTS, THE CONTACT SUBROUTINES SHOULD BE REVISED. THIS

SHOULD INCLUDE A BETTER FORMULATION OF THE FORCE-DEFLECTION CHARACTERISTICS TO ACCOUNT FOR VELOCITY OF IMPACT AND THE MUTUAL DEFORMABILITY OF THE SEGMENTS AND THE SURFACES. THE OPTIONS FOR SPECIFYING THE POINT OF APPLICATION OF THE RESISTING FORCE SHOULD BE LOOKED INTO. THE EFFECT OF NONUNIFORMITY IN SEGMENT GEOMETRY AND MECHANICAL PROPERTIES MAY NEED SOME STUDY. A NEW APPROACH TO SENSE CONTACT BETWEEN SMALL PLANES SHOULD BE MADE SO THAT ELLIPSOID-TO-ELLIPSOID CONTACT CAN BE SIMULATED IN THE SAME WAY AS ELLIPSOID-PLANE CONTACT. PREDICTION OF FRACTURE BY THE USE OF THE EQUATIONS OF ELASTICITY IS ANOTHER ADVANCE THAT SHOULD BE MADE TO UPDATE THIS SOPHISTICATED MODEL.

by ARVIND J. PADGAONKAR  
WAYNE STATE UNIV., DETROIT, MICH.  
DOT-HS-146-3-711  
1976; 317P 22REFS  
DOCTORAL DISSERTATION.  
Availability: UNIVERSITY MICROFILMS  
INTERNATIONAL, ANN ARBOR, MICH.

HS-022 717

#### **THE EFFECT OF ADVERSE VISIBILITY ON DRIVER STEERING PERFORMANCE IN AN AUTOMOBILE SIMULATOR**

THE DRIVER'S ABILITY TO CONTROL THE LATERAL POSITION OF AN AUTOMOBILE DEPENDS ON HIS PERCEPTION OF THE COMMAND PATH (ROADWAY) TO BE FOLLOWED, A PERCEPTION AFFECTED BY BOTH THE CONFIGURATION OF ROAD MARKINGS AND OTHER FEATURES AND BY THE VISIBILITY OF THESE ELEMENTS. TO INVESTIGATE THE THEORY THAT DRIVER PERFORMANCE SHOULD DEGRADE WITH REDUCED PREVIEW AND CONFIGURATIONAL PARAMETERS WHICH CHARACTERIZE THE INTERMITTENT NATURE OF DELINEATION (E.G. DASHED LINES), A SIMULATION EXPERIMENT WAS MADE IN WHICH DRIVER BEHAVIOR AND DRIVER/VEHICLE SYSTEM PERFORMANCE WERE MEASURED OVER A RANGE OF VISIBILITY AND CONFIGURATION PARAMETER VARIATIONS. DRIVER DYNAMIC RESPONSE AND NOISE (REMANT) WERE RELIABLY AFFECTED BY VARIATIONS IN VISIBILITY AND CONFIGURATION. THESE EFFECTS WERE ALSO REFLECTED IN SYSTEM PERFORMANCE MEASURES SUCH AS LANE DEVIATIONS. THE RESULTS SUGGEST MINIMUM PERCEPTUAL (VISIBILITY) REQUIREMENTS FOR THE DRIVER TO MAINTAIN ADEQUATE STEERING CONTROL OF A CAR UNDER REDUCED VISIBILITY CONDITIONS.

by R. WADE ALLEN; DUANE T. MCRUER  
SYSTEMS TECHNOLOGY, INC.  
Rept. No. SAE-770239; 1977; 15P 18REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 718

### FULL SCALE EXPERIMENTAL SIMULATION OF PEDESTRIAN-VEHICLE IMPACTS

A COMPLETE AND COMPREHENSIVE QUANTITATIVE SET OF EXPERIMENTAL SIMULATIONS OF PEDESTRIAN-VEHICULAR ACCIDENTS WAS CONDUCTED. BODY SEGMENT KINEMATICS FROM FIVE DUMMY AND FIVE CADAVER RUNS WERE RECORDED. ANTHROPOMETRIC DATA AND INERTIAL DATA WERE COMPILED FOR FOUR CADAVERS, TWO MALE AND TWO FEMALE. SOME COMPARISONS OF THESE DATA WITH THOSE OBTAINED BY OTHER INVESTIGATORS SHOW THAT THE DATA ARE REASONABLE. THERE IS A SHORTAGE OF INERTIAL DATA OF BODY SEGMENTS, AND RESULTS OF THIS STUDY CONSTITUTE A SIGNIFICANT CONTRIBUTION TO THIS TYPE OF DATA. THE ANTHROPOMORPHIC DUMMY WAS FOUND TO BE A MARGINAL SURROGATE FOR A PEDESTRIAN SUBJECT; IN SEVERAL RUNS IT WAS SHOWN THAT THE EXTREME STIFFNESS OF THE DUMMY AS COMPARED TO THAT OF THE CADAVER RESULTED IN AN UNREALISTIC SIMULATION. THE FORCE-DEFLECTION PROPERTIES OF TWO TYPES OF SURFACE-TO-SEGMENT INTERACTIONS DURING A PEDESTRIAN-VEHICLE IMPACT WERE MEASURED, AND THESE RESULTS CAN BE USED TO OBTAIN A BETTER UNDERSTANDING OF THE CONTACT FORCES INVOLVED DURING IMPACT AS WELL AS ACT AS A GUIDE IN THE DEVELOPMENT OF BETTER CONTACT MODELS IN GROSS MOTION SIMULATIONS. ACCELERATION DATA OBTAINED CAN BE UTILIZED TO ASSESS THE POTENTIAL SOURCES OF IMPACT INJURIES IN A PEDESTRIAN ACCIDENT. INJURIES ASSOCIATED WITH GROUND IMPACT WERE COMPARED WITH THOSE EXPERIENCED DURING IMPACT WITH THE VEHICLE. ALTHOUGH THE ACQUIRED DATA WERE FROM A LIMITED NUMBER OF RUNS, THEY ARE SUFFICIENT TO INDICATE THAT THE ACCELERATION LEVELS EXPERIENCED BY A BODY SEGMENT DEPENDS ON THE COMPLIANCE OF ITS ENERGY ABSORPTION CAPABILITY OF THE IMPACT VELOCITY. HIGH VELOCITY IMPACTS ON THE HOOD ARE JUST AS SEVERE AS LOW VELOCITY IMPACTS ON THE GROUND. FINALLY, THE PIN JOINT ASSUMPTION FOR THE KNEE WAS SHOWN TO BE ERRONEOUS IN EVERY CADAVER RUN. THE KNEE OF THE CADAVER WAS CAPABLE OF LATERAL FLEXION UP TO 20° TO 30° DEGREES DURING A LATERAL IMPACT. EVEN DURING THE DUMMY RUNS THE LEG WAS BENT BELOW THE KNEE.

by KENNETH WAYNE KRIEGER  
WAYNE STATE UNIV., DETROIT, MICH.  
DOT-HS-146-3-711  
1976; 292P 13REFS  
DOCTORAL DISSERTATION. SPONSORED, IN PART, BY NATIONAL SCIENCE FOUNDATION.  
Availability: UNIVERSITY MICROFILMS INTERNATIONAL, ANN ARBOR, MICH.

HS-022 719

### COMPUTER SIMULATION OF MOTORCYCLE ACCIDENTS

COMPUTER SIMULATIONS WERE MADE OF MOTORCYCLE ACCIDENTS FOR TWO-DIMENSIONAL MOTION OF A MOTORCYCLE AND RIDER, THREE-DIMENSIONAL MOTION OF A MOTORCYCLE WITH RIDER RIGIDLY ATTACHED, AND THREE-DIMENSIONAL MOTION OF A MOTORCYCLE AND RIDER. THE LAGRANGIAN FORMULATION OF DYNAMICS WAS USED TO DEVELOP THE EQUATIONS OF MOTION FOR THE TWO-DIMENSIONAL MOTORCYCLE AND RIDER. THE CONSTRAINTS OF HANDS OR FEET BEING IN PLACE ON THE HANDLEBARS OR FOOTPEGS, AND THE PELVIS SLIDING ON THE UPPER CONTOUR OF THE MOTORCYCLE WERE INTRODUCED INTO THE EQUATIONS OF MOTION BY MEANS OF LAGRANGE UNDETERMINED MULTIPLIERS IN SUCH A WAY THAT NONHOLONOMIC CONSTRAINTS WERE PERMISSIBLE, AND THE CONSTRAINT FORCES WERE FOUND AS A BY-PRODUCT OF INTEGRATING THE EQUATIONS OF MOTION USING RUNGE-KUTTA NUMERICAL PROCEDURE. THE EQUATIONS OF MOTION OF A MOTORCYCLE WITH RIGIDLY ATTACHED RIDER IN THREE DIMENSIONS WERE DEVELOPED USING EULER'S EQUATIONS OF RIGID BODY DYNAMICS. THE COMPUTER PROGRAMS USED TO SOLVE THE EQUATIONS OF MOTION OF THE MOTORCYCLE WITH RIGID RIDER WAS COMBINED WITH AN EXISTING PROGRAM THAT SIMULATES THE THREE-DIMENSIONAL MOTION OF A VEHICLE OCCUPANT TO MAKE A SIMULATION OF THE THREE-DIMENSIONAL MOTION OF A MOTORCYCLE AND RIDER.

by ROBERT EDWARD KNIGHT  
UNIVERSITY OF DENVER, DENVER, COLO.  
FH-11-7307; DOT-HS-126-1-186; DOT-HS-123-3-643  
1976; 151P 16REFS  
DOCTORAL DISSERTATION.  
Availability: UNIVERSITY MICROFILMS INTERNATIONAL, ANN ARBOR, MICH.

HS-022 722

### MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS 1971. VOL. 8. OFFICIAL RULINGS ON REQUESTS FOR INTERPRETATIONS, CHANGES, AND EXPERIMENTATIONS

THE REQUESTS HAVE BEEN CATEGORIZED BY SUBJECT INTO SIGNS, MARKINGS, SIGNALS, CONSTRUCTION AND MAINTENANCE, AND BICYCLES TO CORRESPOND WITH THE FIVE TECHNICAL SUBCOMMITTEES OF THE NATIONAL ADVISORY COM. ON UNIFORM TRAFFIC CONTROL DEVICES. IN ADDITION, A NUMBER HAS BEEN ASSIGNED TO INDICATE THE SEQUENCE OF SUBMISSION AND ABBREVIATIONS FOR CHANGE, INTERPRETATION, AND EXPERIMENTATION TO INDICATE THE PURPOSE OF EACH REQUEST. EACH REQUEST HAS BEEN OFFICIALLY RULED ON BY THE FEDERAL HWY. ADMINISTRATOR WITH AN APPROPRIATE ACTION (APPROVED, APPROVED AS MODIFIED, DENIED,

CLARIFICATION) AND EFFECTIVE DATE GIVEN FOR EACH.

FEDERAL HWY. ADMINISTRATION, WASHINGTON,  
D.C. 20590  
1977; 98P  
Availability: CORPORATE AUTHOR

HS-022 723

## **HAND CONTROLS AND ASSISTIVE DEVICES FOR THE PHYSICALLY DISABLED DRIVER**

THE MOST EFFECTIVE ADAPTATIONS, HAND CONTROLS, AND ASSISTIVE DEVICES FOR EACH FUNCTIONAL DISABILITY HAVE BEEN DETERMINED AND COMPILED IN THIS MANUAL FOR THE BENEFIT OF DISABLED DRIVERS, DRIVER EDUCATORS, AND REHABILITATION COUNSELORS. ASSISTIVE DEVICES AND HAND CONTROLS SHOULD BE RECOMMENDED ONLY WHEN ABSOLUTELY NECESSARY FOR SAFE DRIVING, AND SHOULD BE STANDARD EQUIPMENT WHENEVER POSSIBLE. A PRACTICAL EVALUATION OF FUNCTIONAL DISABILITIES IS INCLUDED, WITH A SUMMARY OF HAND CONTROLS, ASSISTIVE DEVICES, AND MODIFIED VANS, AND A GUIDE TO THE USE OF HAND CONTROLS AND ASSISTIVE DEVICES. ADVANTAGES AND DISADVANTAGES OF THE THREE TYPES OF HAND CONTROLS (PULL-PUSH, TWIST-PUSH, AND RIGHT ANGLE PUSH) ARE EXPLAINED, WITH ILLUSTRATIVE PHOTOGRAPHS AND DIAGRAMS. ASSISTIVE DEVICES, DIVIDED INTO CATEGORIES AS STEERING DEVICES, TRANSFER AIDS, AND CONTROL EXTENSIONS ARE SIMILARLY ILLUSTRATED, WITH ADDITIONAL SPECIFIC DEVICES AND COMPLETE FOOT CONTROL. DRIVING AIDS AND CONTROLS ARE SUGGESTED FOR SPECIFIC DISABILITIES. ADAPTATIONS FOR VANS ARE ILLUSTRATED. A GUIDE TO THE USE OF HAND CONTROLS AND ASSISTIVE DEVICES, AND A LIST OF DEFINITIONS OF COMMONLY USED TERMS RELATING TO HANDICAPS, ARE APPENDED. THE IMPORTANCE OF CAREFUL ANALYSIS OF POTENTIALS AND LIMITATIONS ON AN INDIVIDUAL BASIS BY THE DISABLED DRIVER, DRIVER EDUCATOR OR REHABILITATION COUNSELOR IS STRESSED, WITH THE USE OF THE MANUAL ONLY AS A SUPPLEMENT.

by MENAHEM LESS; EDWARD C. COLVERD; JOHN J. DILLON; JUDY YOUNG  
HUMAN RESOURCES CENTER, ADAPTED DRIVER EDUCATION, ALBERTSON, N.Y. 11506  
1977; 61P  
DEVELOPED UNDER NHTSA GRANT.  
Availability: CORPORATE AUTHOR

HS-022 724

## **COMMERCIAL VEHICLES IN THE MOTORIZATION OF JAPAN**

STATISTICS ON THE PERCENTAGE OF COMMERCIAL VEHICLES IN PRODUCTION AND ON THE ROADS IN JAPAN ARE COMPARED WITH THOSE FROM THE ADVANCED MOTORIZED NATIONS AND THE DEVELOPING COUNTRIES. THE RELATIVELY HIGH PERCENTAGE OF COMMERCIAL VEHICLES IN JAPAN IN COM-

PARISON TO THE FIVE OTHER HIGHLY INDUSTRIALIZED NATIONS IS EXPLAINED BY THE NEED FOR RECONSTRUCTION AFTER 1945, BY THE SPECIAL DEMAND FOR MILITARY VEHICLES DURING THE KOREAN WAR, AND BY THE INTRODUCTION OF ADVANCED AUTOMOBILE PRODUCTION TECHNOLOGY. A SURVEY IS MADE OF THE EARLY HISTORY OF JAPAN'S MOTOR VEHICLE PRODUCTION, FROM 1914 THROUGH WORLD WAR II, AND OF THE RECONSTRUCTION PROCESS AFTER THAT WAR. IN 1948 THE SAEJ EVALUATED JAPANESE-MADE VEHICLES AS MARKEDLY INFERIOR TO FOREIGN VEHICLES IN RIDEABILITY, SAFETY, AND DURABILITY; AFTER TEN YEARS OF EFFORT DOMESTIC VEHICLE PERFORMANCE EQUALED THAT OF FOREIGN PRODUCTS. THE SWITCH FROM A RECOVERY TO A GROWTH CYCLE STIMULATED PRODUCTION OF SMALL THREE-WHEELED AND LATER, FOUR-WHEELED TRUCKS. BY 1964, JAPAN'S MOTORIZATION HAD DEVELOPED INTO A PATTERN OF SMALL VEHICLES AS THE DOMINANT TYPE IN ALL PRODUCTION CATEGORIES, WITH SMALL FOUR-WHEELED TRUCKS DOMINANT IN THE TRUCK CATEGORY, A PATTERN WHICH CONTINUES. ONE FACTOR CONTRIBUTING TO SMALL SIZE AND LIGHT WEIGHT, BESIDES ENVIRONMENTAL LIMITATIONS, WAS THE GOVERNMENT REGULATIONS EMPHASIZING THESE CHARACTERISTICS. DURABILITY AND GOOD ACCELERATION, HILL CLIMBING POWER AND GAS MILEAGE PERFORMANCE WERE REQUIRED BY JAPAN'S MOUNTAINOUS TOPOGRAPHY AND INFERIOR ROADS, PLUS THE POSTWAR VEHICLE SHORTAGE WHICH LED TO OVERLOADING. A WIDE RANGE OF PRODUCTS HAS NOW BEEN DEVELOPED: FUEL-EFFICIENT DIESEL TRUCKS AND BUSES, JET ENGINES FOR PLANES, ROTARY PISTON AND GAS TURBINE ENGINES, AND EVERY VARIETY OF TRUCK AND TRUCK CHASSIS, RANGING IN CAPACITY FROM 350 KILOGRAMS TO 500 TONS.

by TERUO MIYAMOTO  
Publ: THE WHEEL EXTENDED V7 N3 P2-9 (WINTER 1977)  
1977  
Availability: SEE PUBLICATION

HS-022 725

## **PATIENCE WITH PEDESTRIANS**

CONCERN FOR THE PEDESTRIAN ON THE PART OF THE AUTOMOBILE DRIVER REQUIRES ALERTNESS AND PATIENCE. IN THE NATION AS A WHOLE, 17 OUT OF EVERY 100 FATALITIES ARE PEDESTRIANS; IN BIG CITIES, THEY ACCOUNT FOR ABOUT HALF THE TRAFFIC FATALITIES. DRIVERS BETWEEN 17 AND 19 STRIKE ABOUT TWICE AS MANY PEOPLE WITH THEIR VEHICLES AS WOULD BE EXPECTED FROM THEIR NUMBERS, PERHAPS BECAUSE OF LACK OF EXPERIENCE AND ALSO UNPREPAREDNESS FOR PEDESTRIAN ERROR. CHILDREN UNDER SIX WHO TEND TO DART OUT INTO TRAFFIC, AND SENIOR CITIZENS WHO MAY BE SLOW-MOVING AT INTERSECTIONS ARE ESPECIALLY VULNERABLE. ALCOHOL IS ALSO A PEDESTRIAN PROBLEM. A SE-



RIES OF PHOTOGRAPHS ILLUSTRATES VARIOUS PEDESTRIAN RISKS.

Publ: DRIVER V11 N9 P14-7 (FEB 1978)  
1978

DATA FROM PEDESTRIAN SAFETY BRANCH, NHTSA.  
Availability: SEE PUBLICATION

HS-022 726

### SEEING FOR SAFE DRIVING

SKILL, ATTITUDE, AND PHYSICAL COORDINATION ARE IMPORTANT TO SAFE DRIVING, BUT GOOD VISION IS THE CHIEF REQUISITE. ANY DEFICIENCY IN VISUAL ACUITY, DEPTH PERCEPTION, PERIPHERAL VISION OR COLOR PERCEPTION MUST BE RECOGNIZED AND COMPENSATED FOR. ALCOHOL AFFECTS VISION IN SEVERAL WAYS, CAUSING DOUBLE VISION, FUZZY VISION, AND REDUCING PERIPHERAL AND NIGHT VISION. SMOKING CAN CAUSE A VISION HAZARD; DRUGS, LEGAL AND ILLEGAL, MAY BE DETRIMENTAL. THE EFFECTS OF ANY PRESCRIBED MEDICATION ON DRIVING ABILITY SHOULD ALWAYS BE ASCERTAINED FROM THE DOCTOR. FATIGUE AND AGE ALSO ADVERSELY AFFECT THE ABILITY TO SEE, THOUGH EXPERIENCE AND ATTITUDE CAN MAKE UP FOR SOME PHYSICAL DEFICIENCIES. REGULAR EXAMINATIONS BY A VISION SPECIALIST ARE RECOMMENDED. PHOTOGRAPHS ILLUSTRATE THE APPEARANCE OF A SCENE TO PERSONS WITH VARIOUS SIGHT DEFECTS.

by CHARLES RAY

Publ: DRIVER V11 N7 P10-3 (FEB 1978)  
1978

Availability: SEE PUBLICATION

HS-022 727

### YOUR DRIVING COSTS

INFORMATION IS PROVIDED ON METHODS OF FIGURING OPERATING COSTS FOR PRIVATE PASSENGER CARS, ALLOWANCES FOR CARS USED ON COMPANY BUSINESS, ECONOMY OF COMPACT CARS, AND VACATION TRAVEL COSTS, PLUS GAS-SAVING TIPS. VARIABLE COSTS OF CAR OWNERSHIP INCLUDE GAS AND OIL OPERATING COSTS, MAINTENANCE EXPENSE AND TIRE COSTS; FIXED COSTS INCLUDE INSURANCE, LICENSE AND REGISTRATION FEES AND TAXES, AND DEPRECIATION. A METHOD OF COMPUTING ANNUAL DRIVING COSTS IS EXPLAINED. FIGURES FOR LOW COST AND HIGH COST AREAS ARE SHOWN, INDICATIVE OF THE COST RATIO BETWEEN CAR CATEGORIES THROUGHOUT THE NATION, AND THE PER MILE COSTS FOR SUBCOMPACTS, COMPACTS, INTERMEDIATES AND STANDARD SIZE CARS COMPUTED. ESTIMATES ARE GIVEN FOR AVERAGE VACATION EXPENDITURES, WITH SUGGESTIONS FOR STRETCHING THE DOLLAR. ITEMS AFFECTING GAS MILEAGE ARE LISTED, INCLUDING WEIGHT, AIR CONDITIONING, AUTOMATIC TRANSMISSION, HIGH SPEEDS, FAST ACCELERATION AND HARD BRAKING; PROPER INFLATION OF TIRES AND PROPER MAINTENANCE ARE RECOMMENDED. REIMBURSING EMPLOYEES WHO USE THEIR OWN CARS

ON COMPANY BUSINESS MAY BE DONE WITH FLAT MILEAGE ALLOWANCE, INVOLVING MINIMUM OF BOOKKEEPING AND OFFICE CONTROL BUT SOMETIMES RESULTING IN OVERPAYMENT OR UNDERPAYMENT COMPARED TO ACTUAL COSTS, OR WITH A WEEKLY ALLOWANCE BASED ON THE NUMBER OF MILES DRIVEN PER WEEK AND THE TYPE OF DRIVING, WHICH MORE ACCURATELY REFLECTS OPERATING COSTS, BUT CAN BE APPLIED ONLY TO CARS OPERATED MORE OR LESS CONSTANTLY ON COMPANY BUSINESS. A MANAGEMENT CONSULTING FIRM, RUNZHEIMER AND CO., IS MENTIONED AS PROVIDING SERVICES ON AUTOMOBILE STANDARD ALLOWANCES, AND RECOMMENDED FOR ORGANIZATIONS OPERATING FLEETS OF TEN OR MORE CARS.

AMERICAN AUTOMOBILE ASSOC., 8111 GATEHOUSE RD., FALLS CHURCH, VA. 22042  
1977; 8P

Availability: CORPORATE AUTHOR

HS-022 728

### MOPEDS--BICYCLE OR MOTORCYCLE?

A STUDY WAS MADE TO DETERMINE WHETHER MOPEDS SHOULD BE CONSIDERED AS BICYCLES AND THEREFORE FREE OF REGULATION, OR AS MOTORCYCLES, AND THUS SUBJECT TO ALL REGULATIONS APPLICABLE TO MOTOR VEHICLES. IN AN EFFORT TO RESOLVE THE ISSUE, EUROPEAN ACCIDENT DATA, VIRGINIA CRASH DATA, THE LAWS OF THE SEVERAL STATES, THE POSITION TAKEN BY A NUMBER OF THE MAJOR TRANSPORTATION RELATED ORGANIZATIONS, AND PUBLIC OPINIONS WERE REVIEWED. IN TERMS OF CRASH, INJURY AND FATALITY DATA, MOPEDS ARE MORE LIKE MOTORCYCLES THAN BICYCLES. WHEN THE NUMBER OF VEHICLES IN USE WERE CONSIDERED, MOPEDS ACCOUNTED FOR SEVEN TIMES MORE DEATHS THAN DID BICYCLES, BUT ONLY ONE THIRD AS MANY AS MOTORCYCLES. THE LAWS OF THE VARIOUS STATES LACK A UNIFORM APPROACH IN DEALING WITH MOPEDS AS A FORM OF TRANSPORTATION. BOTH ORGANIZATIONAL AND PUBLIC OPINIONS TEND TO SUPPORT SOME TYPE OF REGULATION, BUT THERE IS LITTLE AGREEMENT ON THE SPECIFIC AREAS IN WHICH THERE IS A NEED FOR REGULATION AND HOW COMPREHENSIVE IT SHOULD BE. FROM THE REVIEW MADE FOR THIS STUDY, IT IS RECOMMENDED THAT A SEPARATE CATEGORY OF VEHICLES BE ESTABLISHED FOR MOPEDS, AS THEY ARE NEITHER BICYCLES NOR MOTORCYCLES, THAT THE VEHICLES BE REGISTERED, THEIR OPERATORS BE LICENSED, MAXIMUM ALLOWABLE SPEED AND HORSEPOWER BE INCREASED TO 30 MPH AND 1.5 BHP, AND LIABILITY INSURANCE BE MADE AVAILABLE FOR PURCHASE BY MOPED OWNERS.

by CHARLES B. STOKE

HIGHWAY SAFETY DIV. OF VIRGINIA, VIRGINIA HWY. AND TRANSPORTATION RES. COUNCIL, CHARLOTTESVILLE, VA.

Rept. No. VHTRC-78-R33; 1978; 32P 20REFS

Availability: CORPORATE AUTHOR



HS-022 729

# **REPEAL AND MODIFICATION OF MANDATORY MOTORCYCLE HELMET LEGISLATION. A REVIEW OF AVAILABLE INFORMATION**

OVER 60 SCIENTIFIC STUDIES CONCERNING MANDATORY MOTORCYCLE HELMET USAGE PUBLISHED BY RESEARCH ORGANIZATIONS OR IN JOURNALS WERE REVIEWED; RESULTS ARE PRESENTED OF A SURVEY OF STATES THAT HAVE REPEALED THEIR LAWS. FROM THE INFORMATION AVAILABLE, IT WAS DETERMINED THAT THE USE OF MOTORCYCLE HELMETS REDUCES THE INCIDENCE OF SERIOUS AND FATAL HEAD INJURY AMONG MOTORCYCLISTS WITHOUT INTERFERING WITH THEIR ABILITY TO OPERATE THEIR VEHICLES SAFELY. IN RHODE ISLAND AND CONNECTICUT, REPEAL OF THE MANDATORY HELMET LAW HAS RESULTED IN SIGNIFICANTLY INCREASED INJURIES AND FATALITIES. IT IS CONCLUDED THAT THE LAWS ARE CONSTITUTIONAL AND HAVE THE SUPPORT OF BOTH THE GENERAL PUBLIC AND MOTORCYCLISTS IN VIRGINIA, AND IT IS RECOMMENDED THAT THE VIRGINIA GENERAL ASSEMBLY NOT REPEAL OR MODIFY THE CURRENT STATUTES ON MANDATORY HELMET USE. A LIST OF COURT DECISIONS AND LEGAL OPINIONS CONCERNING THE CONSTITUTIONALITY OF STATE MOTORCYCLE HELMET LAWS, AS OF 1 DEC 1976, IS APPENDED.

by CHERYL W. LYNN  
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HWY. AND TRANSPORTATION RES. COUNCIL,  
CHARLOTTESVILLE, VA.  
Rept. No. VHTRC-78-R30; 1978; 48P 64REFS  
Availability: CORPORATE AUTHOR

HS-022 730

# **THE EFFECTS OF RANGE VS. NON-RANGE DRIVER TRAINING ON THE ACCIDENT AND CONVICTION FREQUENCIES OF YOUNG DRIVERS. FINAL REPORT**

A SAMPLE CONSISTING OF 2057 HIGH SCHOOL STUDENTS FROM FIVE CALIFORNIA SCHOOLS WAS ASSIGNED RANDOMLY EITHER TO A TRADITIONAL DRIVER TRAINING PROGRAM (918 STUDENTS) OR TO AN EXPERIMENTAL PROGRAM UTILIZING AN AUTOMOBILE DRIVING RANGE (1139 STUDENTS). ASPECTS OF THEIR PERFORMANCE DURING DRIVER TRAINING WERE MEASURED, AS WELL AS PERFORMANCE ON TESTS REQUIRED FOR DRIVER LICENSING AND THE NUMBER OF DAYS BETWEEN TRAINING AND LICENSING. IN ADDITION, CALIFORNIA DEPT. OF MOTOR VEHICLES FILES SUPPLIED INFORMATION ON THEIR ACCIDENT AND CONVICTION RECORDS WITHIN THE YEAR FOLLOWING THE BEGINNING OF DRIVER TRAINING. RESULTS SHOWED THAT NONRANGE STUDENTS PERFORMED SIGNIFICANTLY BETTER ON THE FOLLOWING TRAINING VARIABLES: KNOWLEDGE POSTTEST, SIMULATOR SCORE, AND DRIVER COURSE GRADE. THERE WERE NO SIGNIFICANT DIFFERENCES BETWEEN RANGE AND NONRANGE STUDENTS ON DRIVER LICENSING TEST SCORES OR IN THE

AMOUNT OF TIME SPENT IN BECOMING LICENSED. HOWEVER, RANGE STUDENTS HAD FEWER TOTAL ACCIDENTS THAN NONRANGE STUDENTS IN THE YEAR FOLLOWING THE BEGINNING OF TRAINING. TIME SPENT ON THE RANGE DURING TRAINING WAS NOT RELATED TO FREQUENCY OF ACCIDENTS OR CONVICTIONS FOR RANGE STUDENTS. RANGE TRAINING IS OPERATIONALLY LESS EXPENSIVE THAN TRADITIONAL TRAINING, BUT COSTS OF CONSTRUCTING A DRIVING RANGE MAY VARY APPRECIABLY.

by DELL R. DREYER; MARY K. JANKE  
CALIFORNIA DEPT. OF MOTOR VEHICLES, RES. AND DEVEL. SECTION, SACRAMENTO, CALIF. 95809  
73.089  
Rept. No. CAL-DMV-RSS-77-58; 1977; 58P 23REFS  
SUBCONTRACTED FROM SAN JUAN (CALIF.) UNIFIED SCHOOL DISTRICT, GRANT DE7103-1203.  
Availability: NTIS

HS-022 731

# **AN ANALYSIS OF ACCIDENTS WITH REGARD TO SAFETY BELTS. ONE STUDY YEAR (1976) ON SERIOUS AND FATAL INJURIES SUFFERED BY OCCUPANTS OF AUTOMOBILES WHO HAD FASTENED THEIR SEAT BELTS (ANALYSE DES ACCIDENTS PAR RAPPORT AUX CEINTURES DE SECURITE. UNE ANNEE D'ETUDE (1976) SUR LES BLESSURES GRAVES ET MORTELLES SUBIES PAR DES OCCUPANTS DE VOITURES AUTOMOBILES QUI AVAIENT ATTACHE LEUR CEINTURE DE SECURITE)**

PURPOSE OF THE STUDY WAS TO REVEAL TO WHAT EXTENT SEAT BELTS CAN CAUSE INJURIES AND IN WHAT ACCIDENT SITUATIONS THEY CANNOT PREVENT SUCH INJURIES. FOLLOWING LEGISLATION IN SWITZERLAND IN 1976 MAKING THE WEARING OF SAFETY BELTS MANDATORY, A NUMBER OF ACCIDENTS WERE ANALYZED IN WHICH 257 SEVERELY INJURED PEOPLE AND 153 WHO WERE KILLED HAD FASTENED THEIR SAFETY BELTS. OF THE 410 PERSONS WEARING SEAT BELTS SURVEYED IN THE STUDY, FIVE PROBABLY HAD MORE SERIOUS INJURIES THAN IF THEY HAD NOT BEEN WEARING BELTS. (TWO WERE IN THE SAME VEHICLE AND A COMPARABLE SITUATION, WHICH REDUCES THE NEGATIVE EFFECT FROM FIVE DIFFERENT ACCIDENT CONDITIONS TO FOUR). IT WAS ESTIMATED FROM THE 1976 STATISTICS OF INJURIES AND FATALITIES IN SWITZERLAND THAT THE RISK OF THE SEAT BELT CAUSING INJURIES MORE SEVERE THAN THEY WOULD HAVE BEEN WITHOUT THE BELT DOES NOT EXCEED 0.65%. ALMOST HALF OF THE VICTIMS WERE WEARING THE SEAT BELTS INCORRECTLY: TOO LOOSELY OR WITH A TWISTED STRAP. HEAD-ON COLLISIONS WERE FOUND TO BE MOST DANGEROUS; COMPLEX ACCIDENTS WITH A HIGH LEVEL OF TRAUMATISM WERE IN SECOND PLACE; LATERAL COLLISIONS CAME NEXT. VARIOUS TYPES OF INJURIES ARE DISCUSSED; USE OF SAFETY BELTS CONTRIBUTES TO REDUCING THEIR NUMBER IN GENERAL, AND BETTER ARRANGEMENT OF THE ANCHORING POINTS OF THE BELTS COULD REDUCE IT FURTHER. TECHNICAL FLAWS IN

SAFETY BELTS AND ANCHORING SYSTEMS CURRENTLY IN USE ARE CONSIDERED. A POSSIBLE METHOD OF IMPROVED ACCIDENT RECONSTRUCTION BY MEANS OF LARGE COMPUTERS IS MENTIONED, AS WELL AS METHODS OF DETERMINING IF THE VICTIM OF AN ACCIDENT WAS WEARING HIS BELT, BY TECHNICAL ANALYSIS OF THE BELT AND VEHICLE. POSSIBLE WAYS OF IMPROVING THE PROTECTION OFFERED BY SEAT BELTS INCLUDE PROPER PLACEMENT OF ANCHORING POINTS, INSTALLATION OF AUTOMATIC BELTS, AND PERIODIC CHECKS OF BELTS. IMPROVEMENT OF STEERING COLUMNS AND STEERING WHEELS TO PREVENT HEAD INJURIES IS RECOMMENDED, WITH REDUCTION OF AVERAGE TRAVELING SPEEDS AND DEVELOPMENT OF EFFECTIVE RESTRAINING DEVICES FOR REAR SEAT PASSENGERS. APPENDED IS A GROUP OF 58 PHOTOGRAPHS OF ACCIDENTS AND DETAILS OF DAMAGE.

by F. WALZ; U. ZOLLINGER; A. RENFER; R. WEGMANN; M. MEIER; P. NIEDERER; H. RUDIN  
UNIVERSITE ET EPF DE ZURICH, GROUPE DE TRAVAIL INTERDISCIPLINAIRE POUR LA MECANIQUE DES ACCIDENTS, SWITZERLAND 1977; 398P 144REFS  
TEXT ALSO IN FRENCH.  
Availability: DEPARTEMENT FEDERAL DE JUSTICE ET POLICE, BERNE, SWITZERLAND

HS-022 733

#### **WHEEL ALIGNMENT--PT. 1. THE CONCEPT OF "WHEEL ALIGNMENT EQUALS MOTION BALANCE"**

THE CONCEPT OF "WHEEL ALIGNMENT EQUALS MOTION BALANCE" REFERS TO THE FACT THAT CORRECT VEHICLE ALIGNMENT INVOLVES BALANCING ALL OF THE FORCES CREATED BY FRICTION, GRAVITY, CENTRIFUGAL FORCE, AND MOMENTUM, WHILE A VEHICLE IS IN MOTION. THERE IS MUCH MORE TO ALIGNMENT THAN SIMPLY ADJUSTING THE WHEELS TO CERTAIN MECHANICAL SETTINGS. THE FOLLOWING BASIC ASPECTS OF WHEEL ALIGNMENT ARE OUTLINED IN NONTECHNICAL TERMS: CONDITION OF SUSPENSION COMPONENTS AND TIRES, ALIGNMENT ANGLES (CAMBER, CASTER, TOE, AND CENTER-POINT STEERING), UNUSUAL TIRE WEAR RELATED TO MISALIGNMENT (EXCESSIVE WEAR ON THE OUTSIDE SHOULDER OF THE TIRE TREAD, TIRE WEAR ON THE INNER SHOULDER, WEAR ON THE INNER AND OUTER SHOULDERS OF FRONT TIRES, EXCESSIVE WEAR ON THE CENTER OF THE TREADS, CUPPING OR DISHING OF TREAD, AND SAW-TOOTH WEAR ON TREAD), MANUFACTURER SPECIFICATION SHEETS FOR PARTICULAR MAKES AND MODELS, AND REAR-WHEEL MISALIGNMENT.

Publ: NTDRA DEALER NEWS V41 N5 P19-26 (13-20 MAR 1978)  
1978  
THE TIRE SERVICE SPECIALIST  
Availability: SEE PUBLICATION

HS-022 734

#### **NEEDED--ADVANCED DRIVER TRAINING TO CUT POLICE ACCIDENT LOSSES**

A POLICE OFFICER IS GENERALLY NOT EVALUATED ON THE BASIS OF HIS/HER DRIVING RECORD UPON JOINING THE FORCE. IT IS ASSUMED THAT HE/SHE WILL TEAM UP WITH A PARTNER, AND THE TWO OF THEM WILL DEVELOP THEIR DRIVING SKILLS JOINTLY IN THE LINE OF DUTY. THIS HAPPENS ONLY TO A LIMITED EXTENT. ALSO, THE AVERAGE PATROL OFFICER TENDS TO FEEL THAT HE/SHE IS PROTECTED BY THE RED LIGHT AND SIREN. THERE ARE FEW NATIONWIDE STATISTICS ON ACCIDENT RATES IN LAW ENFORCEMENT AGENCIES. ONE STUDY SPONSORED BY THE COMMONWEALTH OF VIRGINIA ON EMERGENCY VEHICLE TRAINING SHOWED THAT OF THE APPROXIMATELY 4200 NEEDED OPERATORS OF EMERGENCY VEHICLES PER YEAR, 8% HAD RECEIVED NO DRIVER TRAINING, WHILE 78% HAD RECEIVED LIMITED CLASSROOM INSTRUCTION, AND 14% HAD RECEIVED TRAINING DURING TESTS DESIGNED TO EVALUATE THEIR ABILITY TO DRIVE UNDER EMERGENCY CONDITIONS. NONE HAD RECEIVED BEHIND-THE-WHEEL DRIVER TRAINING DESIGNED TO IMPROVE THEIR DRIVING ABILITY. THE STUDY ALSO REPORTED THAT IN 1972 A TOTAL OF 1129 EMERGENCY VEHICLES WERE INVOLVED IN REPORTABLE ACCIDENTS IN VIRGINIA (NINE FATAL AND 255 PERSONAL INJURY CRASHES). AUTHORITIES IN TRAFFIC SAFETY, DEPARTMENTS OF EDUCATION AND LAW ENFORCEMENT AGENCIES ARE RAPIDLY COMING TO THE CONCLUSION THAT EVENTUALLY SOME FORM OF ADVANCED DRIVER TRAINING WILL BE MANDATORY FOR ALL HOLDERS OF VEHICLE OPERATORS' LICENSES, THE AMOUNT OF TRAINING VARYING WITH THE COMPLEXITY OF THE DRIVING REQUIRED. A SURVEY OF 618 GRADUATES (LAW ENFORCEMENT PERSONNEL) OF THE ACADEMY OF DEFENSIVE DRIVING'S (ORANGE COUNTY, CALIF.) ADVANCED DRIVER EDUCATION PROGRAM (THREE DAY, EIGHT-HOUR DAY, BEHIND-THE-WHEEL COURSE) SHOWED THAT SIX STUDENTS HAD BEEN CHARGEABLE ACCIDENTS IN THE YEAR AFTER GRADUATION. BASED ON COMMENTS FROM CHIEFS OF POLICE WHO HAD SENT THEIR ENTIRE DEPARTMENTS THROUGH ADVANCED DRIVER TRAINING, IT IS REASONABLE TO CONCLUDE THAT ANNUAL ACCIDENT RATES CAN BE IMPROVED BY AS MUCH AS 50%-75%. FUNDING FOR ADVANCED DRIVER TRAINING PROGRAMS FOR POLICE DEPARTMENTS CAN COME IN THE FORM OF IN-HOUSE ALLOCATIONS, GRANTS THROUGH STATE DEPARTMENTS OF HIGHWAY SAFETY, STATE COMMISSIONS (E.G. COMMISSION ON PEACE OFFICER STANDARDS AND TRAINING (PCOST) IN CALIFORNIA, WHICH DERIVES ITS FUNDS FROM A PERCENTAGE OF FINES COLLECTED FOR TRAFFIC VIOLATIONS), AND CITY BUDGETS.

by WALTER MAHURIN  
Publ: TRAFFIC SAFETY V78 N3 P18-20, 28 (1978)  
1978; 2REFS  
Availability: SEE PUBLICATION

HS-022 735

## VEHICLE EXHAUST EMISSION INSTRUMENTS EVALUATION

AFTER CONDUCTING A MARKET SURVEY AND IDENTIFYING ALL EXHAUST EMISSION ANALYZER MANUFACTURERS WHOSE PRODUCT COULD BE USED IN VEHICLE INSPECTION/MAINTENANCE (I/M) PROGRAMS, A REPRESENTATIVE GROUP OF INSTRUMENTS WAS SELECTED AND A SERIES OF TESTS WAS CONDUCTED TO EVALUATE INSTRUMENT PERFORMANCE. LABORATORY TESTS, VEHICLE EXHAUST GAS RESPONSE TESTS, AND INSTRUMENT DURABILITY TESTS WERE CONDUCTED FOR EACH INSTRUMENT. THE FOLLOWING EQUIPMENT WAS ANALYZED AND INDIVIDUAL REPORTS ARE PROVIDED: HORIBA MEXA 300A INFRARED EXHAUST ANALYZER, BARNES 8335C EMISSION ANALYZER, SCOTT IIIC EXHAUST EMISSION ANALYZER, MARQUETTE 42-160 INFRARED EMISSIONS ANALYZER, BECKMAN 590 HC/CO TESTER, STEWART WARNER 3161 INFRARED GAS ANALYZER, SUN EPA 75 EXHAUST PERFORMANCE ANALYZER, MOPAR IIIC EXHAUST EMISSION ANALYZER, SEARS 713.21022 HC-CO ANALYZER, KAL EQUIP 4094-D INFRARED EMISSIONS ANALYZER, PULSAR 662 INFRARED ANALYZER, AUTOSCAN 710C HC/CO ANALYZER, ALLEN 23-160 CA CO/CH INFRARED EXHAUST EMISSION ANALYZER, AUTONSENSE 200 ENGINE DIAGNOSTIC AND EXHAUST EMISSION ANALYZER, HORIBA MEXA 240 INFRARED ANALYZER, THERMO ELECTRON 8A NO ANALYZER, AND IBC N322 W/SC-400 NITROGEN OXIDE ANALYZER. ONE MAJOR FINDING OF THIS STUDY IS THAT THERE ARE PRESENTLY AVAILABLE A SIGNIFICANT NUMBER OF HYDROCARBON/CARBON MONOXIDE (HC/CO) EMISSION ANALYZERS. THE VAST MAJORITY OF HC/CO INSTRUMENTS USE AN INFRARED ABSORPTION OPERATING PRINCIPLE. ANOTHER MAJOR FINDING IS THAT THE HYDROCARBON RESPONSE CHARACTERISTICS OF THE HC/CO INSTRUMENTS GENERALLY SHOWED GREATEST SENSITIVITY TO ISOBUTYLENE, FOLLOWED BY TOLUENE, METHANE, AND ETHYLENE. THE UNITS DEMONSTRATED ESSENTIALLY NO SENSITIVITY TO ACETYLENE AND BENZENE.

by STEVE N. SCHLINGMANN  
OLSON LABS., INC., 421 E. CERRITOS AVE., ANAHEIM,  
CALIF. 92805  
EPA-68-03-2353  
Rept. No. EPA-460/3-77-014; PB-274 547; 1977; 363P  
Availability: NTIS

HS-022 736

## ALCOHOL AND YOUNG DRIVERS: IMPACT AND IMPLICATIONS OF LOWERING THE DRINKING AGE

IN ORDER TO ASSESS THE IMPACT OF LOWERING THE LEGAL DRINKING AGE, THE COLLISION BEHAVIOR OF YOUNG DRIVERS IN A SINGLE COMMUNITY (LONDON, ONTARIO) WAS STUDIED OVER A PERIOD OF TIME THAT INCLUDED THREE AND ONE-HALF YEARS PRIOR TO THE CHANGE IN THE DRINKING AGE AND FOUR YEARS AFTER THE CHANGE IN

THE DRINKING AGE. THE DRINKING AGE WAS LOWERED FROM TWENTY-ONE TO EIGHTEEN IN JUL 1971. THE EVALUATION OF THE IMPACT OF THIS CHANGE WAS CONDUCTED WITHIN THE CONTEXT OF A DETAILED EXAMINATION OF THE AVAILABLE LITERATURE ON THIS TOPIC AND A CRITICAL ASSESSMENT OF THE MAJOR ISSUES INVOLVED. MARKED INCREASES IN THE COLLISION BEHAVIOR OF YOUNG DRIVERS WERE OBSERVED, ESPECIALLY ALCOHOL-INVOLVED COLLISIONS. CONSIDERATION WAS GIVEN TO ALTERNATIVE HYPOTHESES THAT MIGHT ACCOUNT FOR THIS FINDING OTHER THAN THE LOWERING OF THE DRINKING AGE (E.G. REPORTING PRACTICES OF THE POLICE). IN THE FINAL ANALYSIS, THE INFERENCE IS MADE THAT THE LOWERING OF THE LEGAL DRINKING AGE HAD A REAL EFFECT IN INCREASING ALCOHOL-RELATED DAMAGE AMONG YOUNG PEOPLE IN THE FORM OF AN INCREASED INCIDENCE OF ALCOHOL-RELATED COLLISIONS. IF THERE IS TO BE NO INCREASE, AND POSSIBLY A DECREASE, IN RATES OF DAMAGE IN THE FUTURE, THIS WILL LIKELY REQUIRE NO INCREASES AND MAYBE SOME DECREASES IN AVERAGE LEVELS OF CONSUMPTION OF ALCOHOLIC BEVERAGES. THIS WILL REQUIRE THE APPLICATION OF CONTROL MEASURES THAT ALTER THE SOCIAL, ECONOMIC, AND LEGAL COMPONENTS OF THE ENVIRONMENT. SOME OF THE CONTROL MEASURES INCLUDE A POLICY OF TAX/PRICE CONTROL THAT KEEPS ALCOHOLIC BEVERAGES FROM BECOMING MORE ECONOMICALLY ACCESSIBLE, PASSAGE OF MINIMUM DRINKING AGE LAWS THAT KEEP ALCOHOLIC BEVERAGES OUT OF HIGH SCHOOLS, ENFORCEMENT OF LAWS THAT RESTRICT AVAILABILITY OF ALCOHOLIC BEVERAGES, AND PASSAGE OF LEGISLATION THAT IS APT TO DETER THE INTRODUCTION OF ADDITIONAL DRINKING PRACTICES.

by PAUL C. WHITEHEAD  
UNIVERSITY OF WESTERN ONTARIO, DEPT. OF  
SOCIOLOGY, LONDON, ONT., CANADA  
Rept. No. MONOGRAPH SER-1; 1977; 79P 119REFS  
Availability: HEALTH AND WELFARE CANADA, NON-MEDICAL USE OF DRUGS DIRECTORATE, RES. BUREAU

HS-022 737

## FEASIBILITY STUDY: TRAFFIC CASE DISPOSITION REPORTING VIA COMPUTER TAPE. A REPORT ON THE FEASIBILITY OF USING COMPUTER TAPE TO TRANSMIT DISPOSITION DATA FROM AUTOMATED COUNTY COURTS TO THE DEPARTMENT OF HIGHWAY SAFETY AND MOTOR VEHICLES IN FLORIDA

A STUDY WAS UNDERTAKEN TO DETERMINE THE MOST FEASIBLE OF THREE SYSTEMS FOR PROCESSING TRAFFIC CASE DISPOSITIONS FROM 16 AUTOMATED COUNTY COURTS IN FLORIDA TO THE STATE'S DEPT. OF HWY. SAFETY AND MOTOR VEHICLES (DHSMV). ALL COURTS HANDLING TRAFFIC CASES ARE REQUIRED TO REPORT THE DISPOSITION OF EACH CASE, WHETHER IT INVOLVES A CONVICTION OR AN ACQUITTAL, TO THE DHSMV WITHIN TEN DAYS OF THE ADJUDICATION. THIS INVOLVES

BEEN ISSUED TO A DEFENDANT ON A STANDARD UTC FORM, COPIES 1 AND 2 ARE THEN FORWARDED TOGETHER TO THE APPROPRIATE COUNTY COURT (AUTOMATED OR NONAUTOMATED). COPY 1 IS GENERALLY USED BY THE COUNTY COURT TO CREATE AN ARREST RECORD. DISPOSITION DATA ARE ENTERED INTO THE COURT'S SYSTEM USING VARIOUS OTHER DISPOSITION RECORD SOURCES, EITHER MANUALLY OR BY COMPUTER. THE BACK SIDE OF COPY 2 IS THEN COMPLETED AND FORWARDED TO THE DHSMV. THE DHSMV THEN SCREENS THE DATA AND CODES THEM FOR COMPUTER ENTRY. UNDER ALTERNATIVE SYSTEM NO. 1, ALL TRAFFIC CASE DISPOSITIONS FROM NONAUTOMATED COUNTY COURTS WOULD BE PROCESSED MANUALLY AS CURRENTLY BEING DONE. FROM THE AUTOMATED COUNTY COURTS, TRAFFIC CASE DISPOSITIONS ON OUT-OF-STATE DRIVERS WOULD BE PROCESSED MANUALLY AND FORWARDED TO THE DHSMV AS CURRENTLY PERFORMED. ALL OTHER DISPOSITIONS WOULD BE FORMATTED ON A COMPUTER TAPE AT THE COUNTY LEVEL, USING A STANDARD RECORD LAYOUT. A COURT CERTIFIED COMPUTER LISTING WOULD BE REQUIRED TO ACCOMPANY EACH TAPE. UNDER ALTERNATIVE SYSTEM NO. 2, ALL TRAFFIC CASE DISPOSITIONS FROM NONAUTOMATED COUNTY COURTS WOULD BE PROCESSED MANUALLY AS PRESENTLY DONE. ALSO, THE FOLLOWING AUTOMATED COUNTY DISPOSITIONS WOULD BE PROCESSED AS THEY ARE CURRENTLY BEING DONE MANUALLY: ALL DISPOSITIONS ON OUT-OF-STATE DRIVERS, CIVIL INFRACTIONS ON IN-STATE DRIVERS WITH DRIVER IMPROVEMENT (DI) INFORMATION (ANY LICENSE ACTION TAKEN BY COURT), AND MISDEMEANORS ON IN-STATE DRIVERS. ALL CIVIL INFRACTIONS FROM AUTOMATED COUNTIES ON DRIVERS LICENSED IN FLORIDA WITHOUT DI INFORMATION WOULD BE PROCESSED BY COMPUTER TAPE. AFTER TAKING INTO CONSIDERATION VARIOUS ITEMS (DEVELOPMENTAL AND OPERATIONAL COSTS, DATA NEEDS OF OTHER STATES, FLORIDA COUNTY COURT CLERKS' NEEDS, FLORIDA COUNTY COURT TRAFFIC JUDGES' REQUIREMENTS, DHSMV DATA REQUIREMENTS, ENHANCEMENT OF ERROR CORRECTION PROCESS), THE FEASIBILITY OF CHANGING FROM THE CURRENT OPERATING SYSTEM TO ALTERNATIVE SYSTEM NO. 1 IS INDICATED IF CERTAIN LEGAL CONSTRAINTS AND CODE INCOMPATIBILITIES CAN BE RECTIFIED.

by MICHAEL P. ONDER; RANDOLPH LENCZYK; RAM SINGH

FLORIDA DEPT. OF HWY. SAFETY AND MOTOR VEHICLES, OFFICE OF SAFETY INFORMATION AND RES. SERVICES, NEIL KIRKMAN BLDG., ROOM 473, TALLAHASSEE, FLA. 32301  
1977; 95P

Availability: CORPORATE AUTHOR

INFORMATION IS PRESENTED WHICH PROVIDES COMPARISON OF SEMI-ANNUAL MOTOR VEHICLE INSPECTION SYSTEMS AND ANNUAL INSPECTION SYSTEMS. A REVIEW OF THE LITERATURE DEALING WITH THE SIMILARITIES AND DIFFERENCES BETWEEN THE TWO TYPES OF PROGRAMS WAS CONDUCTED. SOME OF THE REPORTS REVIEWED INVESTIGATED THE CAUSES OF MOTOR VEHICLE ACCIDENTS, WHILE OTHERS EXAMINED THE EFFECTS OF PERIODIC MOTOR VEHICLE INSPECTION PROGRAMS ON THE MECHANICAL CONDITION OF VEHICLES AND VEHICLE ACCIDENT RATES. ALSO INCLUDED WERE STUDIES WHICH EXAMINED THE INFLUENCE OF AGE AND MILEAGE FACTORS ON THE CONDITION OF VEHICLES. GENERALLY, THE LITERATURE SUPPORTS AN INSPECTION SYSTEM BASED ON AGE AND MILEAGE FACTORS. ON THE BASIS OF THE LITERATURE REVIEWED, A BENEFIT-COST ANALYSIS COMPARING THE STATE OF VIRGINIA'S SEMI-ANNUAL INSPECTION PROGRAM WITH A THEORETICAL ANNUAL INSPECTION PROGRAM WAS PERFORMED. THE RESULTS SHOWED THAT THE ANNUAL PROGRAM WAS MORE COST-BENEFICIAL, ALTHOUGH SEMI-ANNUAL PROGRAMS MAY ALSO RETURN BENEFITS IN THE REDUCTION OF COSTS TO THE PUBLIC.

by JOHN J. ABBENE

VIRGINIA HWY. AND TRANSPORTATION RES. COUNCIL, CHARLOTTESVILLE, VA.

Rept. No. VHTRC-78-R36; 1978; 44P 26REFS

SPONSORED BY HWY. SAFETY DIV. OF VIRGINIA.

Availability: CORPORATE AUTHOR

HS-022 739

## SEALS KEEP DIRT OUT, LUBRICANT IN [ON BALL BEARINGS AND ROLLER BEARINGS]

A DISCUSSION OF THE TYPES OF BALL-BEARING AND ROLLER-BEARING SEALS AVAILABLE AND THE FACTORS INVOLVED IN THEIR SELECTION IS PRESENTED AS A GUIDE FOR DESIGNERS. THE SELECTION OF A ROLLER-BEARING SEAL IS BASED ON THE FUNCTION OF THE SEAL AND THE OPERATING CONDITIONS OF THE BEARING APPLICATION. THE EXCLUSION OF CONTAMINANTS CAN BE EITHER THE PRIMARY OR SECONDARY FUNCTION OF THE SEAL, WITH THE TYPE OF CONTAMINANT BEING AN ESSENTIAL FACTOR IN SELECTION. THE SAME IS TRUE OF LUBRICANT RETENTION, WITH THE TYPE AND DEGREE OF RETENTION SERVING AS DETERMINANTS. THERE ARE TWO BASIC TYPES OF SEALS, CONTACTING AND NONCONTACTING. THE LATTER INVOLVE NO PHYSICAL CONTACT BETWEEN THE INTERFACE MEMBERS WHICH ARE USED TO FORM THE EXCLUSION OR RETENTION BARRIER. THEY CONSIST OF LABYRINTHS AND NONCONTACTING HYDRODYNAMIC SEALS, AND HAVE NO MAXIMUM SPEED LIMITATION SINCE THEY ARE NOT RESTRICTED BY FRICTION. SUCH SEALS DOMINATE IN THE UPPER SPEED RANGES WHERE THE HEAT GENERATED BY CONTACTING SEALS

NONCONTACTING SEALS LEND THEM-  
TO LOW VOLUME MANUFACTURING  
AND ARE OFTEN USED ON UNIQUE  
EQUIPMENT FOR WHICH CATALOG CON-  
EALS ARE NOT AVAILABLE. FACE SEALS  
LIP SEALS ARE THE TWO BASIC TYPES  
CTING SEALS. THEY ARE PRODUCED IN  
/ERY CONCEIVABLE CONFIGURATION IN-  
FIXTURES OF THE TWO THAT SHARE PRI-  
SECONDARY DUTIES. THEY MAY BE  
TO CONFORM TO THE AVAILABLE SPACE  
THE DOMINANT MEANS OF PROTECTING  
OLLER BEARINGS, WITH THE RADIAL LIP  
3 USED MOST FREQUENTLY.

MOTIVE ENGINEERING V86 N2 P56-61 (FEB

SAE-780401 "SEALING CONSIDERATIONS  
ED ROLLER BEARINGS," BY DENNIS LEE  
SENT AT SAE CONGRESS, DETROIT, 27  
1978.  
SEE PUBLICATION

### **S' REACTOR IMPROVES CONVERSION CY [EMISSION PERFORMANCE OF LEAN REACTOR]**

OF A RECENT INVESTIGATION BY  
MOTORS RES. LAB. WHICH SHOW THAT  
RBON (HC) AND CARBON MONOXIDE (CO)  
ON CAN BE IMPROVED BY OPTIMIZING A  
RMAL REACTOR'S INSULATION, VOLUME,  
FIGURATION, ARE PRESENTED. USING A  
REACTOR WHICH PROVIDES INDEPEN-  
TROL OF VOLUME, INTERNAL CONFIGU-  
ND HEAT LOSS, THE EMISSION EFFECTS  
THERMAL REACTOR GAS MEAN RE-  
TIME AND RESIDENCE TIME DISTRIBUTION  
E INVESTIGATED. MEAN RESIDENCE TIME  
NTLY INFLUENCES THE PERFORMANCE  
NSULATED REACTORS, WHILE HIGH HEAT  
UCES THAT INFLUENCE. CONFIGURATION  
WHICH IMPROVE RTD IMPROVE REACTOR  
ANCE IRRESPECTIVE OF HEAT LOSS, WITH  
ATED "2-PASS" REACTOR BEING NEAR OP-

MOTIVE ENGINEERING V86 N2 P62-6 (FEB

SAE-780008 "EMISSIONS PERFORMANCE OF  
RMAL REACTOR--EFFECTS OF VOLUME,  
ATION, AND HEAT LOSS," BY RONALD J.  
RESENTED AT SAE CONGRESS, DETROIT,  
AR 1978.  
SEE PUBLICATION

NEW YORK STATE'S RECENT MOPED LEGISLATION  
IS DISCUSSED FROM THE PERSPECTIVE OF THE  
STATE OF NEW YORK DEPT. OF MOTOR VEHICLES.  
THE 1977 NEW YORK STATE LEGISLATURE DROPPED  
ITS "DESIGNATED AREA" CONCEPT, A GEOGRAPHI-  
CAL AREA WITHIN WHICH THE MOPEDS COULD  
LEGALLY BE OPERATED. IT ALSO DEALT  
REASONABLY WITH THE PROBLEM OF OPERATING  
SOME LOW-SPEED MOPEDS AS BICYCLES ("FIRST  
GENERATION" TYPE OF MOPED WHICH IS INCAPA-  
BLE OF ATTAINING SPEEDS HIGHER THAN 17 MPH  
AND WHICH CONSTITUTES 90%-95% OF THE MAR-  
KET). THE NEW MOPED LAW ENACTED ON 11 AUG  
1977 DEFINES A "BICYCLE" ACCORDING TO ITS PRE-  
1976 STATUS SO THAT THE BICYCLE CATEGORY IN-  
CLUDES VEHICLES OPERATED BY HUMAN POWER  
ONLY AND NOT BY MOTIVE POWER. THE LEGISLA-  
TION CONSIDERS ALL TWO-WHEELED AND THREE-  
WHEELED DEVICES DESIGNED TO BE OPERATED BY  
A MOTOR AS MOTOR VEHICLES, INCLUDING THOSE  
PREVIOUSLY SOLD AS BICYCLES. ALSO, THE FOL-  
LOWING THREE CLASSES OF LIMITED-USE MOTOR-  
CYCLES WERE DEFINED IN THE NEW LEGISLATION:  
CLASS A, THOSE WITH A MANUFACTURER'S CER-  
TIFIED MAXIMUM SPEED OF 31-40 MPH; CLASS B,  
THOSE WITH A MANUFACTURER'S CERTIFIED MAX-  
IMUM SPEED OF 21-30 MPH; AND CLASS C, THOSE  
WITH A MANUFACTURER'S CERTIFIED MAXIMUM  
SPEED OF 20 MPH OR LESS. UNDER THE NEW LAW,  
ALL MOPEDS ARE TO BE REGISTERED AND ALL  
OPERATORS WILL BE LICENSED (EITHER WITH A  
GENERAL DRIVER LICENSE FOR CLASSES B AND C,  
OR WITH A MOTORCYCLE OR MOTORCYCLE-TYPE  
LICENSE FOR CLASS A). NO LIMITED-USE MOTORCY-  
CLE CAN BE OPERATED ON A CONTROLLED-ACCESS  
HIGHWAY, AND OPERATORS OF CLASS B AND CLASS  
C VEHICLES MUST USE ONLY THE RIGHTHAND  
LANE OF THE HIGHWAY OR A USEABLE SHOULDER  
EXCEPT WHEN PREPARING FOR A LEFT TURN. THE  
STATE OF NEW YORK DEPT. OF MOTOR VEHICLES  
STRONGLY SUPPORTS THE USE OF HELMETS AND  
EYE PROTECTION BY ALL MOPED AND MOTORCY-  
CLE OPERATORS AND IS NOT SATISFIED WITH THE  
EXEMPTION OF CLASS C OPERATORS FROM THESE  
REQUIREMENTS, AS OUTLINED IN THE NEW  
LEGISLATION. SIMILARLY, THE DEPARTMENT IS  
CONCERNED BECAUSE INSPECTION IS NOT  
REQUIRED FOR CLASS C MOPEDS. IN ADDITION, THE  
MOPED PRESENTS ONE MAJOR PROBLEM NOT  
PRESENT WITH THE MOTORCYCLE: THE MOTORCY-  
CLE CAN KEEP UP WITH THE FLOW OF TRAFFIC,  
WHILE THE MOPED CANNOT.

by BASIL Y. SCOTT  
Publ: TRAFFIC SAFETY V78 N3 P8-9, 28 (MAR 1978)  
1978  
Availability: SEE PUBLICATION

HS-022 742

**TOLL UP AGAIN [MOTOR VEHICLE DEATHS 1977]**

STATISTICS ON MOTOR VEHICLE DEATHS IN THE U.S. IN 1977 ARE PRESENTED. INFORMATION IS BROKEN DOWN INTO THE FOLLOWING CATEGORIES: TRAVEL, VEHICLE, DRIVERS; DEATH RATE; TURNPIKE EXPERIENCE; INJURIES; FACTORS AFFECTING MOTOR VEHICLE DEATHS; REGIONAL CHANGES; URBAN-RURAL FATALITY EXPERIENCE; DEATHS BY TYPE OF ACCIDENT; DEATHS BY AGE OF VICTIM; AND STATE AND CITY EXPERIENCE. IN SUMMARY, MOTOR VEHICLE DEATHS INCREASED 5% IN 1977 OVER 1976. THE 1977 TOTAL IS ESTIMATED AT 49,200 COMPARED WITH 46,700 IN 1976. OTHER NATIONAL FIGURES FOR 1977 ARE AS FOLLOWS: MOTOR VEHICLE INJURIES, 1,900,000; COST OF MOTOR VEHICLE ACCIDENTS, \$30,100,000,000; VEHICLE MILES TRAVELED, 1,480,000,000,000; MOTOR VEHICLE DEATH RATE, 3.3 PER 100,000,000 MILES OF TRAVEL; MOTOR VEHICLE REGISTRATION 147,000,000; AND POPULATION, 216,332,000. THE NATIONAL ACCIDENT FATALITY TOLL FOR 1977 FOR ALL TYPES OF ACCIDENTS WAS 104,000, A 4% INCREASE FROM THE 1976 TOTAL.

by J. L. RECHT; BARBARA CARRARO

Publ: TRAFFIC SAFETY V78 N3 P14-7, 22-3, 31 (MAR 1978) 1978; 1REF

Availability: SEE PUBLICATION

HS-022 743

**P/M ADVANCES EXTEND APPLICATION RANGE [POWDER/METALLURGY AUTOMOTIVE PARTS]**

ONLY DURING THE LAST DOZEN YEARS HAVE POWDER METALLURGY (P/M) PARTS BEEN CONSIDERED TO HAVE PHYSICAL PROPERTIES AND CHARACTERISTICS ACCEPTABLE FOR TRUCK TRANSMISSIONS. MANY PARTS INITIALLY DESIGNED FOR WROUGHT MATERIALS ARE NOW MADE VIA P/M. GEAR APPLICATIONS ARE OF PARTICULAR INTEREST AS THEY REQUIRE PRESS CAPACITY, MATERIAL SELECTION, AND THE MINIMUM NUMBER OF REQUIRED SECONDARY OPERATIONS. GEAR SYSTEMS MEET THE DESIGNER'S NEED FOR TRANSMITTING MECHANICAL POWER AND MOTION, OR IN POWER CONVERSION WHERE FLUID AND MECHANICAL POWER ARE INTERCHANGED IN PUMPS AND FLUID MOTORS. APPLICATION OF P/M IN THE FOLLOWING RECOGNIZED GEAR CLASSIFICATIONS IS DISCUSSED: RACKS, STRAIGHT SPUR GEARS, SPUR BEVEL GEARS, SPIRAL BEVEL AND FACE GEARS, HELICAL GEARS, HERRINGBONE GEARS, AND ECCENTRIC GEARS. FUTURE TRENDS IN P/M COMPACTION AND COINING INCLUDE THE FOLLOWING: IMPROVED CONTROL OF PLATEN MOTIONS AND FILL SO THAT LENGTH CONTROL IS BROUGHT DOWN TO TEN THOUSANDTHS OF A CM, AND HIGHER AGMA CLASSES OF GEARS WILL BE POSSIBLE BY DECREASING TAPER AND LEAD ERROR; INCREASED USE OF POWDER MIXES WITHOUT ADMIXED LUBRICANT, USING SYSTEMS OF DIE WALL LUBRICATION TO ATTAIN HIGHER GREEN DENSITIES, AND THEREBY BETTER PERFORMANCE; INCREASING RATE OF P/M FORGING APPLICATIONS FOR GEARS, WITH DEVELOPMENT OF THE PRINCIPLES FOR PREFORM

DESIGN BOTH CREATING NEW APPLICATIONS BENEFITING FROM EACH; AND NEW TOOLING CONCEPTS RESULTING IN INCREASED PRODUCTION OF HELICALS AND POSSIBLY HERRINGBONES. TREND IN SINTERING INCLUDING THE FOLLOWING: IMPROVED IMPACT STRENGTH RESULTING FROM PREPARED WORK ON THE BASIC METALLURGY OF SINTERED STEELS, AND THERMAL DENSIFICATION (HIGH TEMPERATURE VACUUM SINTERING) YIELDING AN ENTIRELY NEW CLASS OF P/M STRUCTURAL ALLOYS.

Publ: AUTOMOTIVE ENGINEERING V86 N2 P51-4 (FEB 1978)

1978; 1REF

BASED ON SAE-780360 "ADVANCES IN P/M GEAR CAPABILITIES," BY N. L. WARD AND S. W. MCGEE, AND SAE-780427 "P/M PARTS IN HEAVY DUTY TRANSMISSIONS," BY EDWARD L. ZAHN, BOTH PRESENTED AT SAE CONGRESS, DETROIT, 27 FEB-MAR 1978. BOTH PAPERS PRINTED IN THEIR ENTIRETY IN THE 1977 NATIONAL POWDER METALLURGY CONFERENCE PROCEEDINGS, VOL. 1 - PROGRESS IN POWDER METALLURGY SERIES. Availability: SEE PUBLICATION

HS-022 744

**PRESENT VEHICULAR PASSENGER DESIGN--IS THERE A SAFER SEATING CONFIGURATION?**

A SAFER SEATING CONFIGURATION FOR PASSENGERS IN AUTOMOBILES IS PROPOSED WHICH IS AN ADAPTATION OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA) HIGH SPEED DESIGN FOR SPACE CAPSULES. THE ASTRONAUTS WERE SITTING IN FORM-FITTING CHAIRS AND HITTING THE WATER BACKWARDS AT 30 M/SEC WITHOUT INJURY. THE ALTERNATIVE AUTOMOBILE SEATING ARRANGEMENT WOULD BE ACCOMPLISHED BY TAKING THE PRESENT CAR INTERIOR AND TURNING THE SEAT AROUND, MOVING THE STEERING WHEEL AROUND, AND DRIVING THE CAR LOOKING INTO A LARGE FRONT-VIEW MIRROR. ADAPTING THIS CONCEPT WOULD INVOLVE JOINTS FOR THE STEERING COLUMN, ADDITIONAL HYDRAULIC LINES FOR THE CONTROLS, AND A SIDE MIRROR. THE FRONT-VIEW MIRROR OFFERS ADDITIONAL SAFETY FEATURES. THE MIRRORING OF THE ROAD HAS NO BLIND SPOTS. OVERLAPPING MIRRORS VISUALLY ELIMINATE THE CORNER POSTS, AND THE CORNER POSTS CAN BE STRONG ENOUGH TO SERVE AS ROLL BARS. THE MIRROR 180° VIEW WILL EXPOSE DANGERS COMING FROM THE SIDES. FILTERS WILL REDUCE GLARE, DAY OR NIGHT.

by PHIL SWANSON

Publ: CALIFORNIA HIGHWAY PATROLMAN V42 N1 P1, 45, 53-4 (MAR 1978) 1978

Availability: SEE PUBLICATION

HS-022 745

**CARRIAGEWAY EDGELINING [ROADWAY EDGE MARKING] AND THE EFFECTS ON ROAD SAFETY**

# THE REPORT OF A TWO-YEAR STUDY IN EAST SUSSEX [ENGLAND]

RESULTS OF A TWO-YEAR STUDY TO DETERMINE THE EFFECT ON ROAD SAFETY OF ADDING REFLECTORIZED SHOULDER MARKINGS TO RURAL ROADS IN EAST SUSSEX, ENGLAND, WERE STATISTICALLY ANALYZED. THE STATISTICAL CONFIDENCE LEVEL THAT THE REDUCTION IN TOTAL ACCIDENTS HAS BEEN SOLELY THE RESULT OF THE PRESENCE OF SHOULDER MARKINGS IS SUCH THAT NO FIRM CONCLUSION CAN BE REACHED. A REDUCTION OF 37% IN ACCIDENTS OCCURRING DURING THE DARK WAS FOUND; HOWEVER, DUE TO THE SMALL NUMBER OF ACCIDENTS INCLUDED, THE CONFIDENCE LEVEL IS ONLY INDICATIVE THAT THIS IS A RESULT OF THE MARKINGS. TAKING INTO ACCOUNT THE REDUCED SEVERITY OF ACCIDENTS RESULTING FROM THE IMPOSITION OF A NATIONAL SPEED LIMIT OF 50 MPH DURING THE STUDY PERIOD, THE SHOULDER MARKINGS HAD AN EFFECT IN REDUCING SLIGHT-INJURY ACCIDENTS AT AN INDICATIVE LEVEL OF CONFIDENCE. FOR ACCIDENTS RELATED TO THE TYPE OF ROAD LAYOUT, SIGNIFICANT REDUCTIONS WERE FOUND IN ACCIDENTS OCCURRING AT NON-JUNCTION AREAS AND ON ROADS WITH GOOD ALIGNMENT. IT WAS FOUND, PERHAPS SURPRISINGLY, THAT THE CONDITIONS UNDER WHICH CONTINUOUS SHOULDER MARKINGS WERE FOUND TO BE THE MOST BENEFICIAL WERE THOSE RELATING TO ROADS WITH GOOD ALIGNMENT DURING DAYLIGHT HOURS AND INVOLVING LOCAL DRIVERS. A SIGNIFICANT REDUCTION IN ACCIDENTS ON BENDS MIGHT HAVE BEEN EXPECTED, BUT THE RESULTS INDICATE THAT AS THE BEND TIGHTENED THE LINES HAD AN ADVERSE EFFECT. THIS COULD BE BECAUSE THE PRESENCE OF THE LINES GIVES THE DRIVER A FALSE CONFIDENCE ON THE APPROACH TO A BEND. FOR THIS STUDY THE SHOULDER MARKINGS WERE CONTINUOUS THROUGHOUT; THIS IS NOT IN ACCORDANCE WITH CURRENT BRITISH REGULATIONS (ACCORDING TO THE REGULATIONS, ONLY 54% OF THE TEST MILEAGE AND 67% OF THE CONTROL ROAD MILEAGE WOULD HAVE BEEN CONTINUOUS, WITH THE REMAINDER DASHED). UNDER WET WEATHER CONDITIONS BOTH IN DAYLIGHT AND IN DARKNESS, THE MARKINGS WERE LESS CONSPICUOUS; THE REDUCTION OF ACCIDENTS IN DRY CONDITIONS IS AT AN INDICATIVE CONFIDENCE LEVEL. FIVE OF THE SEVEN TEST SECTIONS OF ROAD HAD REDUCED ACCIDENTS.

by D. B. CHARNOCK; B. A. C. CHESSELL  
 Publ: TRAFFIC ENGINEERING AND CONTROL V19 N1  
 P4-7 (JAN 1978)  
 1978; 2REFS  
 Availability: SEE PUBLICATION

HS-022 746

## DRIVER EYE LOCATIONS AS DETERMINED BY A T.V. [TELEVISION] SYSTEM

DRIVER EYE LOCATIONS WERE DETERMINED USING A TELEVISION SYSTEM. THE DETERMINATION OF THE LOCATION OF DRIVERS' EYES WITH RESPECT

TO A VEHICLE'S SEATING REFERENCE POINT IS AN IMPORTANT STEP IN VEHICLE DESIGN AND EVALUATION. CURRENT PRACTICE IS TO USE THE EYELLIPSE AS DESCRIBED IN SAE RECOMMENDED PRACTICE J941C. THE EYELLIPSE IS A THREE-DIMENSIONAL DESCRIPTION OF THE EYE LOCATIONS OF 2300 VOLUNTEER SUBJECTS. MEASUREMENTS WERE TAKEN WHILE SUBJECTS VIEWED A STRAIGHT-AHEAD TARGET IN 1963 STANDARD-SIZED AUTOMOBILES, AND THE EYE LOCATIONS WERE REFERENCED TO THE VEHICLE'S STRUCTURE BY PHOTOGRAPHIC METHODS. WITH RESPECT TO GENERATING A NEW EYELLIPSE, THE STUDY REPORTED IS TO BE CONSIDERED EXPLORATORY AND WILL PERMIT ESTIMATIONS OF SAMPLE SIZES FOR THE POSSIBLE GENERATION OF A SECOND EYELLIPSE. DRIVERS' EYE LOCATION DATA WERE COLLECTED IN THREE VEHICLES (1976 VEGA STATION-WAGON, 1973 BUICK LASABRE, AND 1975 CHEVROLET VAN) AND IN THREE ENVIRONMENTS (LABORATORY BUCK, STATIC, AND ON-THE-ROAD) FOR EACH VEHICLE TYPE. IN EACH ENVIRONMENT DATA WERE COLLECTED FOR 50 SUBJECTS WHO WERE STRATIFIED BY HEIGHT AND SEX. A SPECIALLY CONSTRUCTED REMOTE COORDINATE SYSTEM IN CONNECTION WITH TV CAMERAS WAS USED FOR DATA COLLECTION. DRIVERS' EYE LOCATIONS WERE FOUND TO VARY AS A FUNCTION OF VEHICLE TYPE. FOR THE BUICK AND CHEVROLET THERE WERE DIFFERENCES BETWEEN DATA COLLECTED IN THE LABORATORY BUCK AND ON THE ROAD. THERE WERE NO DIFFERENCES IN DATA COLLECTION IN THE STATIC ENVIRONMENT AND ON THE ROAD FOR ANY VEHICLE TYPE.

by RONALD R. MOURANT; TONG-KUN PAK; EFFAT MOUSSA HAMOUDA  
 WAYNE STATE UNIV.  
 Rept. No. SAE-770244; 1977; 8P 4REFS  
 PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION, DETROIT, 28 FEB-4 MAR 1977. SPONSORED BY MOTOR VEHICLE MANUFACTURERS ASSOC. OF THE UNITED STATES, INC.  
 Availability: SAE

HS-022 747

## COMFORTABLE HAND CONTROL REACH OF PASSENGER CAR DRIVERS

IN ORDER TO ESTABLISH BOUNDARIES WITHIN WHICH A CERTAIN PERCENTAGE OF THE SWEDISH DRIVING POPULATION COULD COMFORTABLY REACH AND MANEUVER A CONTROL KNOB WITH A THREE-FINGER GRASP IN ONE PARTICULAR PASSENGER CAR, A TEST WAS UNDERTAKEN INVOLVING 180 SWEDISH LICENSED DRIVERS. THE MAXIMUM HAND REACH CAPABILITY OF DRIVERS HAS ALREADY BEEN ESTABLISHED BY SOCIETY OF AUTOMOTIVE ENGINEERS (SAE), BUT IT WAS FELT THAT THERE IS A CONSIDERABLE DIFFERENCE BETWEEN MAXIMUM AND COMFORTABLE REACH. THE 95% COMFORTABLE HAND CONTROL REACH FOUND IN THIS STUDY WAS COMPARED TO THE APPROPRIATE ISO(SAE) STANDARDS ORGANIZATION) 95% MAXIMUM REACH BOUNDARY TABLE. A TABLE FOR 75%/25% MALE/FEMALE MIX WAS CHOSEN



BECAUSE IT CORRESPONDED CLOSEST TO THE 67%/33% MIX IN THE COMFORTABLE REACH TEST. AS COULD BE EXPECTED THE COMFORTABLE REACH IS MUCH CLOSER TO THE DRIVER THAN THE MAXIMUM REACH. THE ISO/SAE REACH STUDY SHOWS A SIGNIFICANT DIFFERENCE IN THE MAXIMUM REACH OF MEN COMPARED WITH THE MAXIMUM REACH OF WOMEN. NO SUCH DIFFERENCE WAS FOUND IN THIS STUDY. FOR 90% OF THE TEST SUBJECTS AND CONSIDERING ALL 15 PROBES, THE MEN HAD AN AVERAGE OF 1.4 MM LONGER REACH THAN THE WOMEN. NO ATTEMPTS HAVE BEEN MADE TO INTERPRET THE RESULTS OF THIS STUDY TO A GENERAL CONCLUSION FOR DIFFERENT PACKAGE GEOMETRIES, SINCE TOO LITTLE IS KNOWN ABOUT THE INFLUENCE OF AN ADJUSTABLE SEATBACK ANGLE ON THE DRIVER'S PREFERRED SEAT POSITION. SOME DRIVERS ADJUST THE SEATBACK TO ACHIEVE PRIMARILY A COMFORTABLE TORSO POSITION WHILE OTHERS ADJUST TO GET A COMFORTABLE REACH TO THE STEERING WHEEL. THOSE DRIVERS WHO ARE MAINLY CONCERNED WITH THEIR STEERING WHEEL REACH USUALLY ADJUST TO A MORE RECLINED DRIVING POSITION THAN THE OTHERS. THE LARGE SPREAD IN PREFERRED SEATBACK ANGLE SHOWN BY THIS TEST INDICATES THAT THE POSSIBILITY TO ADJUST THIS ANGLE HAS A CONSIDERABLE EFFECT ON THE PREFERRED SEAT POSITION AND THEREBY ALSO ON COMFORTABLE REACH.

by ANDERS HALLEN  
AKTIEBOLAGET VOLVO, CAR DIV.  
Rept. No. SAE-770245; 1977; 11P 4REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 748

# **AN EVALUATION OF WHEEL REMOVAL, DYNAMOMETER AND PLATFORM METHODS OF BRAKE INSPECTION FOR FLORIDA'S COUNTY OPERATED MOTOR VEHICLE INSPECTION PROGRAMS**

AN EVALUATION WAS MADE OF THREE TYPES OF BRAKE INSPECTION (REMOVAL OF THE RIGHT FRONT WHEEL, A DYNAMIC BRAKE ANALYZER, AND A SKID PLATFORM BRAKE TESTER) TO DETERMINE THE BEST METHODOLOGY FOR USE IN FLORIDA'S COUNTY-OPERATED MOTOR VEHICLE INSPECTION PROGRAMS. THE EXISTING PLATFORM METHOD OF BRAKE INSPECTION HAS THE LOWEST COST PER INSPECTION, LOWEST COST PER DEFECT DETECTED, AND THE HIGHEST BENEFIT-COST RATIO. THIS WOULD INDICATE AN UNQUALIFIED RECOMMENDATION THAT THIS METHOD BE CONTINUED. HOWEVER, SUCH A RECOMMENDATION MUST BE QUALIFIED BECAUSE OF THE LOW RELIABILITY OF THE PLATFORM WHICH CREATES UNCERTAINTY ABOUT ITS ACCIDENT PREVENTION CAPABILITY AND ALSO ABOUT PUBLIC CONFIDENCE IN AND SUPPORT OF THE VEHICLE INSPECTION PROGRAM. THE LONG-TERM IMPROVEMENT OF BRAKE INSPECTION MUST CONSIDER MORE RELIABLE METHODS

OF DEFECT DETECTION AND METHODS WHICH MORE SPECIFICALLY GEARED TO THE PROBLEM OF HYDRAULIC DEFECTS. THIS SHOULD INCLUDE EVALUATION OF THE LOW-SPEED DYNAMOMETER WHICH IS PRESENTLY IN PLACE IN THE JACQUETTEVILLE, FLA., EXPERIMENTAL LANE WHERE DATA FOR THIS STUDY WERE COLLECTED (AUGUST 1977). THE EVALUATION SHOULD CONSIDER WAYS OF REDUCING THE NUMBER OF TESTS TO REDUCE THE INSPECTION TIME AND INSPECTION COSTS. THE DATA FROM THE HIGH-SPEED DYNAMOMETER SUGGEST THAT THE HYDRAULIC TEST COULD BE ELIMINATED WITH ONLY THE SMALLEST REDUCTION IN THE NUMBER OF DEFECTS DETECTED. A LONG-TERM APPROACH TO THE PROBLEM OF HYDRAULIC DEFECTS MAY BE THE UTILIZATION OF THE WHEEL REMOVAL METHOD, BUT GIVEN THE IMPACT ON INSPECTION COSTS, OTHER TECHNOLOGIES OF INSPECTION MUST BE CONSIDERED. CHECKING MASTER CYLINDER LEAK LEVELS FOR CONTAMINATION MAY BE A COSTLY INSPECTION METHODOLOGY FOR THIS PROBLEM, BUT FURTHER RESEARCH ON THIS APPROACH IS REQUIRED.

by RICHARD CHACKERIAN; MICHAEL JOZEFCHAK  
FLORIDA STATE UNIV., DEPT. OF PUBLIC  
ADMINISTRATION  
1977; 87P 9REFS  
SPONSORED BY STATE OF FLORIDA, DEPT. OF  
ADMINISTRATION, GOVERNOR'S HWY. SAFETY  
COMMISSION.  
Availability: CORPORATE AUTHOR

HS-022 749

# **TRANSPORT STATISTICS, GREAT BRITAIN 1976**

STATISTICAL TABLES RELATING TO INLAND SURFACE TRANSPORT IN GREAT BRITAIN FOR THE PERIOD 1966-1976 ARE PRESENTED. TWENTY NEW TABLES ARE INCLUDED WHICH DEAL WITH ANALYSES FROM THE 1975/76 NATIONAL TRAFFIC SURVEYS AND COMPARISONS WITH THE RESULTS OF EARLIER SURVEYS. THE FIRST PUBLISHED RESULTS FROM THE DEPT. OF TRANSPORT'S INLAND DISTANCE TRAVEL SURVEYS, TWO NEW TABLES ON ROAD ACCIDENT CASUALTIES, AND FIVE NEW TABLES ON FUEL PRICES AND CONSUMPTION. IN ADDITION, SIX TABLES IN THE PREVIOUS EDITION HAVE BEEN EXTENDED TO PROVIDE DETAILED ANALYSES. FOR EXAMPLE, THE SERIES OF TABLES ON ROAD ACCIDENT STATISTICS HAVE BEEN IMPROVED AND EXPANDED. MOST OF THE TABLES COVER THE 11 YEARS FROM 1966 THROUGH 1976, ALTHOUGH SOME SPAN LONGER OR SHORTER PERIODS AND SOME CONTAIN FORECASTS FOR SEVERAL YEARS AHEAD. TO PROVIDE A WIDER SETTING, THE INLAND SURFACE TRANSPORT SERIES, SUMMARY TABLES ON AIR AND SEA TRANSPORT ARE INCLUDED AS ARE KEY TRANSPORT FIGURES RELATING TO OTHER COUNTRIES. METRIC UNITS ARE GENERALLY USED THROUGHOUT. A Nomenclature AND DEFINITIONS SECTION GIVES DETAILED EXPLANATORY NOTES APPROPRIATE TO THE TABLES AND A SUBJECT INDEX IS PROVIDED. THE COMPOSITION OF TABLES IS DIVIDED INTO THE FOLLOWING



17 PARTS: GENERAL, ROAD EXPENDITURE AND NETWORK, ROAD TRAFFIC, MOTOR VEHICLES (STOCK AND NEW REGISTRATIONS), CAR OWNERSHIP, PUBLIC ROAD PASSENGER TRANSPORT, ROAD GOODS TRANSPORT, DRIVING LICENSES AND TESTS, VEHICLE TESTS, RAILWAYS, ACCIDENTS, INLAND WATERWAYS, SEA TRANSPORT, AIR TRANSPORT, PIPELINES (OIL AND PETROLEUM), INTERNATIONAL, AND MISCELLANEOUS.

DEPARTMENT OF TRANSPORT, STATISTICS  
DIRECTORATE, 2 MARSHAM ST., LONDON SW1P 3EB,  
ENGLAND  
1978; 210P  
PREPARED IN COOPERATION WITH THE SCOTTISH  
DEVEL. DEPT. AND THE WELSH OFFICE.  
Availability: HER MAJESTY'S STATIONERY OFFICE,  
LONDON, ENGLAND 5.75 POUNDS

HS-022 753

**ECONOMIC IMPACT OF HIGHWAY SNOW AND ICE  
CONTROL. FINAL REPORT**

AN IN-DEPTH INVESTIGATION INTO THE ECONOMIC  
IMPACT OF SNOW AND ICE CONTROL ON HIGHWAYS  
INCLUDED STUDY OF MAINTENANCE, TRAFFIC AND  
SAFETY, ENVIRONMENT, STRUCTURE DAMAGE, AND  
VEHICLE CORROSION. A WINTER MAINTENANCE  
QUESTIONNAIRE WAS DISTRIBUTED IN IDAHO, IL-  
LINOIS, MINNESOTA AND UTAH TO DETERMINE THE  
PUBLIC ATTITUDE TOWARD THE MAINTENANCE EF-  
FORT IN EACH STATE, AND THE RESULTS ARE AP-  
PENDED. TRAFFIC AND SAFETY WERE CONSIDERED  
IN TERMS OF THE USER COSTS OCCURRING DURING  
WINTER MAINTENANCE. ACCIDENT RATES, USER  
DELAY, TRAFFIC VOLUMES AND VEHICLE SPEEDS  
DURING SNOW AND ICE STORMS WERE EVALUATED.  
A PHONE SURVEY TO BUSINESSES TO DETERMINE  
THEIR LOSSES RESULTING FROM POOR TRAVELING  
CONDITIONS WAS MADE. ENVIRONMENTAL DAMAGE  
TO WELLS, PLANTS AND LAKES WAS IN-  
VESTIGATED. THE DETERIORATION OF ROADWAY,  
STRUCTURES AND VEHICLES WHICH CAN BE AS-  
SOCIATED WITH WINTER MAINTENANCE WAS CON-  
SIDERED. THE ECONOMIC COMPUTER MODEL, ESIC  
(ECONOMICS OF SNOW AND ICE CONTROL),  
DEVELOPED THROUGH THE STUDY, YIELDS COSTS  
FOR MAINTENANCE AND TRAFFIC AND SAFETY ON  
A PER STORM AND LEVEL-OF-SERVICE BASIS, WRIT-  
TEN WARNING FOR POSSIBLE ENVIRONMENTAL  
DAMAGE, AND ANNUAL COSTS FOR STRUCTURAL  
DETERIORATION AND VEHICLE CORROSION.

by J. C. MCBRIDE; W. J. KENNEDY; J. J. THUET; M. C.  
BELANGIE; R. M. STEWART; C. C. SY; F. R. MCCONKIE  
UTAH DEPT. OF TRANSPORTATION, RES. AND DEVEL.  
UNIT, 757 W. SECOND SOUTH, SALT LAKE CITY,  
UTAH 84104  
DOT-FH-11-8580  
Rept. No. FHWA-RD-77-95; UDOT-MR-77-5; 1977; 133P  
27REFS  
NATIONAL POOLED FUND STUDY; FUNDING  
HIGHWAY AGENCIES INCLUDED THE FEDERAL  
HWY. ADMINISTRATION, IDAHO, ILLINOIS,  
MARYLAND, MICHIGAN, MINNESOTA, MONTANA,  
NEW HAMPSHIRE, SOUTH DAKOTA, UTAH, VIRGINIA,  
AND WASHINGTON.  
Availability: NTIS

HS-022 754

**SPINAL INJURIES IN BELT-WEARING CAR  
OCCUPANTS KILLED BY HEAD-ON COLLISIONS**

IN 34 POSTMORTEM EXAMINATIONS OF CAR OCCU-  
PANTS WHO HAD BEEN WEARING SEAT BELTS AND  
WHO HAD BEEN KILLED IN STRAIGHT OR OBLIQUE  
HEAD-ON COLLISIONS, A THOROUGH INVESTIGA-  
TION OF THE SPINE WAS PERFORMED. THE AUTOPSY  
RESULTS WERE CORRELATED WITH THE FINDINGS  
IN THE CARS IN ORDER TO RECONSTRUCT THE  
EVENTS WHEN THE OCCUPANT'S BODY STRUCK THE  
INTERIOR OF THE CAR. IN TWO CASES THE VICTIMS  
HAD WORN LAP BELTS, IN 15 CASES SHOULDER  
BELTS, AND IN 17 CASES COMBINED SHOULDER-LAP  
BELTS (THREE-POINT BELTS). IN VICTIMS INVOLVED  
IN HEAD-ON COLLISIONS WHILE WEARING LAP  
BELTS, FRACTURES OF THE NEURAL ARCH OF THE  
AXIS WERE FOUND WHICH WERE PROBABLY DUE TO  
FLEXION OF THE NECK PIVOTING ROUND THE  
LOWER PART OF THE IMPACTING FACE AND SIMUL-  
TANEOUS STRETCHING OF THE NECK. SEVERE INJU-  
RIES TO THE CERVICAL SPINE IN THOSE VICTIMS  
WEARING SHOULDER BELTS WERE MAINLY DUE TO  
THE OCCUPANT SLIDING UNDER THE BELT WHICH  
THEN CAUGHT THE NECK AND MANDIBLE. SUCH IN-  
JURIES WERE ALSO CAUSED BY THE IMPACT OF THE  
HEAD AGAINST FORWARD PARTS OF THE CAR. IN  
THOSE WEARING SHOULDER-LAP BELTS, INJURIES  
TO THE UPPER PART OF THE CERVICAL SPINE  
RESULTED FROM THE IMPACT OF THE HEAD  
AGAINST THE INTERIOR PARTS OF THE CAR. WHEN  
A SLIGHT IMPACT OF THE HEAD OCCURRED, MINOR  
INJURIES TO THE LOWER CERVICAL SPINE WERE  
SEEN. INJURIES TO THE THORACOLUMBAR SPINE IN  
THE CASES EXAMINED WERE THE CONSEQUENCE  
OF A VIOLENT EXTENSION BETWEEN THE UPPER  
PART OF THE TRUNK HELD BACK BY THE  
SHOULDER BELT AND THE PELVIS RESTRAINED BY  
THE LAP BELT OR BY THE KNEES STRIKING THE  
FASCIA PANEL. IN FRONT-SEAT OCCUPANTS THIS  
EXTENSION CAN BE INCREASED IF EITHER REAR-  
SEAT OCCUPANTS WITHOUT BELTS OR HEAVY OB-  
JECTS ON THE REAR SEAT ARE PROJECTED AGAINST  
THEIR BACKS.

by GORAN SKOLD; GERHARD E. VOIGT  
Publ: INJURY: THE BRITISH JOURNAL OF ACCIDENT  
SURGERY V9 N2 P151-61 (1977?)  
1977?; 31REFS  
Availability: SEE PUBLICATION

HS-022 755

**THE SEAT BELT WEARING LAW IN SWEDEN AND  
ITS EFFECT ON OCCUPANT INJURIES IN VOLVO  
CARS**

STATISTICAL DATA ARE PRESENTED ON THE EF-  
FECT OF THE LAW REQUIRING USE OF SEAT BELTS  
IN SWEDEN, WHICH BECAME EFFECTIVE 1 JAN 1975,  
ON THE NUMBER AND SERIOUSNESS (ABBREVIATED  
INJURY SCALE, AIS) OF INJURIES SUSTAINED IN  
TRAFFIC ACCIDENTS. THE LAW GOVERNING COM-  
PULSORY USE OF SEAT BELTS STIPULATES THAT  
PERSONS 15 YEARS OF AGE OR OLDER AND A  
HEIGHT OF AT LEAST 150 CM SHALL USE SEAT

TOOK PLACE PRIOR TO THE INTRODUCTION OF THE LAW, 2026 AFTER ITS INTRODUCTION. TOTALLY, 4995 DRIVERS AND 1949 FRONT-SEAT PASSENGERS WERE COVERED IN THE ANALYSIS. A COMPARISON OF SEATBELT USAGE SHOWS 51% WEARING BELTS PRIOR TO THE LAW AND 93% AFTER THE LAW. AFTER THE INTRODUCTION OF THE SEATBELT LAW, THE FOLLOWING REDUCTIONS IN INJURIES WERE FOUND: 19% FOR NUMBER OF INJURED, 16% FOR LIGHT-MODERATE INJURIES (AIS 1-2), 68% FOR BAD-SERIOUS INJURIES (AIS 3-4), 25% FOR CRITICAL-FATAL INJURIES (AIS 5-6), 54% BAD-FATAL CHEST INJURIES, 43% FOR LIGHT-MODERATE HEAD INJURIES, AND 64% FOR BAD-FATAL HEAD INJURIES. THERE WAS AN INCREASE IN LIGHT-MODERATE CHEST INJURIES BY 8%.

by HANS NORIN

AKTIEBOLAGET VOLVO, S-40508 GÖTEBORG, SWEDEN  
Rept. No. TRAFFIC-ACCIDENT-RES-77/2A; 1977; 10P  
Availability: CORPORATE AUTHOR

HS-022 756

# **ASSESSMENT OF THE EFFECT ON TRAFFIC SAFETY OF LOWERING THE LEGAL DRINKING AGE IN ILLINOIS**

AN ASSESSMENT WAS MADE OF THE EFFECT ON TRAFFIC SAFETY OF LOWERING THE LEGAL DRINKING AGE IN ILLINOIS USING CALENDAR YEAR 1975 AS THE PERIOD OF STUDY. THE PRESENT MINIMUM DRINKING AGE IN ILLINOIS IS 19 FOR BEER AND WINE AND 21 FOR DISTILLED LIQUORS. THIS AGE LIMIT HAS BEEN IN EFFECT SINCE OCT 1973, WHEN IT WAS LOWERED FROM 21, AT WHICH AGE IT HAD BEEN PERMISSIBLE TO BUY ALCOHOLIC BEVERAGES OF ALL TYPES. THE PRINCIPAL CONCLUSION OF THE STUDY IS THAT LOWERING THE LEGAL DRINKING AGE CONTRIBUTED TO AN INCREASE OF 1.6% IN THE 1975 FATALITY TOTAL, WHICH REACHED 2085 THAT YEAR. IN ABSOLUTE TERMS THAT ESTIMATED INCREASE EQUATES TO 33 LIVES. ALTHOUGH THIS ANALYSIS DID NOT ATTEMPT TO QUANTIFY THE INJURIES AND PROPERTY DAMAGE ACCIDENTS THAT WERE INVOLVED, IT IS CERTAIN THAT THERE WERE ALSO CONCOMITANT INCREASES IN THOSE TYPES. DESPITE THE INCREASES IN FATAL ACCIDENTS AMONG YOUNGER DRIVERS THAT CAN BE CONNECTED TO ALCOHOL, THE PROBLEM IN ILLINOIS AND NATIONALLY IS BY NO MEANS LIMITED TO THE YOUNGER DRIVERS. THE 19-TO-20-YEAR-OLD DRIVERS ARE ALSO NOT THE WORST OFFENDERS. THE PROBLEM OF DRIVING WHILE INTOXICATED OR UNDER THE INFLUENCE OF ALCOHOL IS SO PERVERSIVE AS TO INCLUDE VIRTUALLY EVERY AGE GROUP OF DRIVERS IN THE STATE.

ILLINOIS DEPT. OF TRANSPORTATION, DIV. OF TRAFFIC SAFETY  
1977; 25P 16REFS  
ILLINOIS TRAFFIC SAFETY PROGRAMS REPT. OF EVALUATION OR ASSESSMENT.  
Availability: CORPORATE AUTHOR

THE FOUR-LAYER LAMINATED SECURITY WINDSHIELD HAS BEEN TESTED IN SIMULATED COLLISIONS UP TO 40 MPH BARRIER EQUIVALENT VELOCITIES (BEV) TO DEMONSTRATE THAT IT CAUSES NO LACERATION, AND HAS BEEN EXPOSED TO USUAL AND EXTREME ENVIRONMENTAL CONDITIONS TO DEMONSTRATE ITS SERVICEABILITY FOR FIELD USE. THE NEW WINDSHIELD CONSISTS OF CONVENTIONAL LAMINATED CONSTRUCTION (GLASS/HIGH PENETRATION RESISTANT LAYER/GLASS) COMBINED WITH A 0.5 MM THICK LAYER OF PLASTIC. GLASS IS USED ON THE SURFACE OF THE WINDSHIELD TO WITHSTAND ABRASION AND SCRATCHING OF WINDSHIELD WIPERS, AND CLEANING. THE LAMINATED CONSTRUCTION PREVENTS PENETRATION AND PROVIDES A POCKET OR CUSHION TO DECELERATE THE HEAD WITHOUT THE INNER LAYER IS MADE OF A SPECIAL FILM WHICH PROTECTS THE FACE OF THE PASSENGERS AGAINST LACERATION AND EYE INJURY DURING HEAD IMPACT. IT ALSO PREVENTS GLASS PARTICLES AND SPLINTERS FROM FLYING FROM THE VEHICLE FROM EXTERNAL IMPACT BY STONES AND OTHER OBJECTS. THE INNER FILM IS ABRASION AND SCRATCH RESISTANT. THE TYPICAL INSTALLATION IN VEHICLES HAS SHOWN THAT IT IS NOT DAMAGED THROUGH NORMAL USE. THE SECURIFLEX CONSTRUCTION HAS BEEN EXPOSED TO HIGH AND LOW TEMPERATURE AND HUMIDITY, CHEMICALS, FOOD, COSMETICS, CIGARETTES, SMOKE, ETC.; IT IS NOT AFFECTED BY THESE AGENTS AND HAS PERFORMED PERFECTLY WELL IN LONG-TERM SERVICE TESTS.

by OTTO JANDELEIT; ROGER ORAIN  
VEREINIGTE GLASWERKE, WEST GERMANY; SECURIFLEX, GOBAIN INDUSTRIES, FRANCE  
Rept. No. SAE-770246; 1977; 16P 3REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION, DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 758

# **50 CAR CARE TIPS TO SAVE YOU MONEY**

FIFTY-FIVE TIPS ON AUTOMOBILE CARE FALL INTO THE CATEGORIES OF THINGS TO CHECK REGULARLY UNDER THE HOOD, MAINTENANCE REPAIRS, TIRE CARE, CARE OF THE FINISH, AND COMMERCIAL PRODUCTS FOR CAR CARE AND MAINTENANCE.

Publ: MOTOR TREND V30 N4 P43-4, 46, 48 (APR 1978)  
Availability: SEE PUBLICATION

NEW TYPES OF AUTOMOBILE TIRES ON THE MARKET AND FUTURE TRENDS ARE DISCUSSED. LAST FALL, GOODYEAR INTRODUCED THE TIEMPO, AN ALL-WEATHER RADIAL THAT THE COMPANY SAYS ELIMINATES THE NEED FOR SNOW TIRES. IN HYDROPLANING TESTS, TIEMPO OUTSCORED THE COMPANY'S TOP-OF-THE-LINE POLYSTEEL RADIAL; AND IT EQUALS THE POLYSTEEL'S RIDE, HANDLING, AND WET-CORNERING CHARACTERISTICS, WHILE SURPASSING IT IN FUEL ECONOMY, HIGH-SPEED HANDLING, AND DRY-PAVEMENT TRACTION. TIEMPO IS CONSTRUCTED OF TWO PLYS OF POLYESTER CORD TOPPED BY TWO BELTS OF STEEL. THE TIRE GETS ITS WINTER TRACTION FROM SHOULDER ELEMENTS EXTENDING 0.5 INCH INTO THE CENTER OF THE TREAD AND FROM RUBBER COMPOUNDS FORMULATED ORIGINALLY FOR THE COMPANY'S ALL WINTER RADIAL. FIRESTONE AND GOODYEAR HAVE ANNOUNCED DEVELOPMENT OF HIGH-PRESSURE RADIALS WHICH THEY SAY WILL INCREASE FUEL ECONOMY BY AS MUCH AS 10%. THE FIRESTONE TIRE IS A VERSION OF ITS 721 STEEL-BELTED RADIAL WHICH CAN BE INFLATED TO PRESSURES AS HIGH AS 35 PSI; ROLLING RESISTANCE IS SAID TO BE ABOUT 35% LESS THAN THAT OF COMPARABLE BIAS AND BIAS-BELTED TIRES. THE TIRE IS NOW AVAILABLE IN THE SIX MOST POPULAR SIZES. GOODYEAR'S TIRE, REFERRED TO AS THE ELLIPTIC, RUNS AT PRESSURES OF 8 TO 12 PSI HIGHER THAN CONVENTIONAL RADIALS. IN SOME CASES THIS MEANS A 50% INCREASE IN TIRE PRESSURE. THE ELLIPTIC'S SUPERIOR ROLLING RESISTANCE IS SAID TO BE PRIMARILY THE RESULT OF THE ELLIPTICAL SHAPE OF THE SIDEWALL. THE SIDEWALL CURVES DOWN TO THE POINT WHERE THE TIRE MEETS THE RIM. COMPETITORS IN THE TIRE INDUSTRY POINT OUT THAT THE ELLIPTIC HAS ONE MAJOR DISADVANTAGE, THE REQUIREMENT FOR A SPECIAL RIM; BUT GOODYEAR REBUTS THIS CRITICISM. THE FINAL STEP IN PRODUCING THE SUPER TIRE IS BEING WORKED ON NOW BY GOODYEAR. RECENTLY THE COMPANY UNVEILED A SO-CALLED FLATPROOF TIRE THAT DEMONSTRATED THE ABILITY TO MAINTAIN ITS LOAD-BEARING SHAPE WITH A 1-FT SECTION REMOVED. ACCORDING TO GOODYEAR, THE DEFLATED TIRE CAN BE DRIVEN APPROXIMATELY 40 MILES AT 40 MPH.

Publ: MACHINE DESIGN V50 N5 P22-4 (9 MAR 1978)  
1978  
Availability: SEE PUBLICATION

HS-022 760

## PAVEMENT SURFACE PROPERTIES AND PERFORMANCE

EIGHT ARTICLES DETAIL VARIOUS METHODS OF EVALUATING PAVEMENT SURFACE PROPERTIES AND VEHICLE PERFORMANCE. HYDROPLANING POTENTIAL OF PAVEMENT IS DEFINED AS THE INABILITY OF THE ACCUMULATED WATER TO ESCAPE FROM THE TIRE PAVEMENT CONTACT AREA, WITH

SEPARATELY ACCORDING TO THE SLOPES OF THE HYDROPLANING-SPEED-EQUIVALENT AND WATER-FILM-THICKNESS CURVES. PAVEMENT GROOVING, A TECHNIQUE BY WHICH LONGITUDINAL OR TRANSVERSE CUTS ARE INTRODUCED ON A SURFACE TO INCREASE SKID RESISTANCE AND REDUCE THE NUMBER OF WET-WEATHER ACCIDENTS, IS MORE BENEFICIAL FOR LOW-FRICTION THAN FOR HIGH-FRICTION PAVEMENT. A PHOTOGRAPHIC TECHNIQUE DEVELOPED FOR DETERMINING SKID NUMBER AND SPEED GRADIENTS OF PAVEMENTS FROM A MOVING VEHICLE HAS BEEN PROVED TO BE EFFICIENT AND ACCURATE. FRICTION MEASUREMENTS WERE MADE WITH A SKID TRAILER AT 40 MPH ON 1460 MILES OF RURAL, TWO-LANE ROADS IN KENTUCKY TO BE USED IN DETERMINING MAINTENANCE PRIORITIES. SEVERAL REPORTED ACCIDENT AND DRIVER BEHAVIOR STUDIES RELATED TO SKID RESISTANCE ARE CRITIQUED IN ORDER TO DETERMINE THE MOST REASONABLE TENTATIVE GUIDELINES FOR USE IN VIRGINIA. REQUIRED SN40 (MINIMUM SKID RESISTANCE) VALUES WILL CONTINUE TO BE USED AS A BASIS FOR SELECTION OF MAINTENANCE PRIORITIES. REVISIONS OF UTAH'S FLEXIBLE PAVEMENT PERFORMANCE SYSTEM ARE DESCRIBED. RIGID-PAVEMENT PERFORMANCE IS PREDICTED FROM CUMULATIVE DEFLECTION HISTORY. THE PERFORMANCE OF THE MAYS ROAD METER IS COMPARED WITH THAT OF THE SURFACE DYNAMICS PROFILOMETER.

NATIONAL ACAD. OF SCIENCES, TRANSPORTATION RES. BOARD, 2101 CONSTITUTION AVE., N.W., WASHINGTON, D.C. 20418  
Rept. No. TRR-633; 1977; 55P REFS  
INCLUDES HS-022 761--HS-022 765. P 344 P  
Availability: CORPORATE AUTHOR \$2.80

HS-022 761

## TECHNIQUE FOR EVALUATING HYDROPLANING POTENTIAL OF PAVEMENTS

HYDROPLANING POTENTIAL OF PAVEMENT IS DEFINED AS THE INABILITY OF THE ACCUMULATED WATER TO ESCAPE FROM THE TIRE PAVEMENT CONTACT AREA. THE POTENTIAL IS MEASURED IN TERMS OF THE SPEED ABOVE WHICH HYDROPLANING OCCURS; THAT IS, THE VEHICLE TIRES ARE LIFTED OFF THE PAVEMENT AND SUPPORTED BY A WATER WEDGE FORMED BETWEEN TIRE SURFACE AND PAVEMENT. FOR THE STANDARDIZATION OF THE MEASUREMENT SYSTEM, VARIOUS TEST CONDITIONS AND TIRES WERE INVESTIGATED. AN INFLATION PRESSURE OF 24 POUNDS PER SQUARE INCH AND A VERTICAL TIRE LOAD OF 650 POUNDS PER FOOT WERE CHOSEN AS THE OPTIMUM PARAMETERS. THE TEST RESULTS IN A STATIONARY TROUGH SHOW THAT THE COMBINATION OF THE ABOVE TEST PARAMETERS AND THE ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS) DESIGNATION E 524 TIRE GIVES VERY LOW VALUES OF FRICTION FORCE AT 50 MILES PER HOUR WHEN

THE WATER-FILM THICKNESS IS 0.05 INCHES. WATER FILMS AS THICK AS 0.05 INCHES WERE OBTAINED FROM THE TESTER WATER WHEN THE WATER JET WAS DELIVERED APPROXIMATELY 6.5 FEET AHEAD OF THE TIRE. THE SPEED ABOVE WHICH HYDROPLANING WILL OCCUR (HYDROPLANING POTENTIAL) ON PAVEMENTS HAVING DIFFERENT TEXTURE DEPTHS CAN BE DETERMINED FROM THE HYDROPLANING SPEED VERSUS WATER-DEPTH CURVES BY MEASURING THE WATER FILM PRESENT AND THE AVERAGE TEXTURE DEPTH OF THE PAVEMENT. THE HYDROPLANING POTENTIAL OF THE RIGID PAVEMENTS AND OF THE FLEXIBLE PAVEMENTS CAN BE GROUPED SEPARATELY ACCORDING TO THE SLOPES OF THE HYDROPLANING-SPEED-EQUIVALENT AND WATER-FILM-THICKNESS CURVES.

by S. K. AGRAWAL; J. J. HENRY  
PENNSYLVANIA STATE UNIV., DEPT. OF  
MECHANICAL ENGINEERING  
Publ: HS-022 760 (TRR-633), "PAVEMENT SURFACE  
PROPERTIES AND PERFORMANCE," WASHINGTON,  
D.C., 1977 P1-7  
1977; 6REFS  
SPONSORED BY PENNSYLVANIA DEPT. OF  
TRANSPORTATION AND FEDERAL HWY.  
ADMINISTRATION.  
Availability: IN HS-022 760

HS-022 762

### EFFECTS OF PAVEMENT GROOVING ON FRICTION, BRAKING, AND VEHICLE CONTROL

PAVEMENT GROOVING IS A TECHNIQUE BY WHICH LONGITUDINAL OR TRANSVERSE CUTS ARE INTRODUCED ON A SURFACE TO INCREASE SKID RESISTANCE AND REDUCE THE NUMBER OF WET-WEATHER ACCIDENTS. THE OBJECTIVE OF THE RESEARCH WAS TO DETERMINE THE EFFECT OF PAVEMENT GROOVING ON MOTORIST SAFETY BY STUDYING THE EFFECTS OF GROOVING ON FRICTION, BRAKING, AND VEHICLE CONTROL BY COMPUTER SIMULATION AND FULL-SCALE TESTING. VEHICLES CONSIDERED WERE AUTOMOBILES, MOTORCYCLES, AND AUTOMOBILE AND TOWED-VEHICLE COMBINATIONS. THE COMPUTER SIMULATION WAS DEVELOPED BY OBTAINING TEST DATA FOR A VARIETY OF CONDITIONS AND PERFORMING A REGRESSION ANALYSIS OF THE DATA. THE RESULT WAS A SET OF EQUATIONS THAT WERE INCORPORATED INTO VEHICLE-HANDLING MODELS THAT PREDICTED VEHICLE RESPONSE DUE TO THE GROOVES. THE MOTORCYCLE RIDER DETECTED A PERCEPTIBLE DIFFERENCE BETWEEN WORN AND UNWORN GROOVING. THE EFFECT OF GROOVING ON MOTORCYCLE RESPONSE COULD NOT BE DETECTED BY ELECTRONIC INSTRUMENTS THAT MEASURED STEERING ANGLE AND TORQUE. NO SIGNIFICANT DIFFERENCE WAS FOUND FOR VARIOUS GROOVING GEOMETRIES. ELECTRONIC INSTRUMENTATION COULD NOT DETECT THE EFFECTS OF GROOVING ON A TYPICAL SMALL AUTOMOBILE AND TOWED-VEHICLE COMBINATION AT DIFFERENT SPEEDS FOR VARIOUS TRAILER AND TONGUE LOADS. BASED ON COMPUTER SIMULATION, THE EFFECT OF GROOVING IS MORE BENEFICIAL FOR LOW-FRICTION THAN

FOR HIGH-FRICTION PAVEMENT; ALSO, GROOVES PROVIDE A NOTICEABLE INCREASE IN THE DIRECTIONAL STABILITY OF A VEHICLE.

by J. E. MARTINEZ  
TEXAS A AND M UNIV., TEXAS TRANSPORTATION  
INST.  
Publ: HS-022 760 (TRR-633), "PAVEMENT SURFACE  
PROPERTIES AND PERFORMANCE," WASHINGTON,  
D.C., 1977 P8-13  
1977; 9REFS  
SPONSORED BY FEDERAL HWY. ADMINISTRATION.  
Availability: IN HS-022 760

HS-022 763

### PHOTOGRAPHIC TECHNIQUE FOR ESTIMATING SKID NUMBER AND SPEED GRADIENTS OF PAVEMENTS

A TECHNIQUE HAS BEEN DEVELOPED FOR DETERMINING SKID NUMBER AND SPEED GRADIENTS OF PAVEMENTS FROM A MOVING VEHICLE. WET-PAVEMENT ACCIDENT RECORDS AND THE MATCHING SKID-NUMBER MEASUREMENTS PROVIDED BY THE 14 STATES PARTICIPATING IN THE STUDY WERE USED. A VAN MOVING AT A SPEED OF 40 MPH PHOTOGRAPHED THE PAVEMENT USING OBLIQUE LIGHTING AND A 35-MM DATA CAMERA. PHOTOGRAPHS WERE MADE OF THE PAVEMENT BY USING A LIGHT AT LOW-INCIDENCE ANGLE TO PROJECT SHADOWS ACROSS THE PEAKS AND VALLEYS OF PAVEMENT MACROTEXTURE. THE PHOTOGRAPHS WERE COMPARED TO STANDARD PHOTOGRAPHS OF PAVEMENTS WITH KNOWN GRADIENTS. THE RATINGS WERE CONVERTED TO ESTIMATED SKID NUMBER AND SPEED GRADIENT BY USING A REGRESSION EQUATION. THE FILM-READING METHOD APPEARED TO WORK BETTER ON PHOTOGRAPHS GATHERED IN THE FIELD THAN ON LABORATORY PHOTOGRAPHS, PROBABLY DUE TO LIGHT LEAKAGE UNDER THE SHROUD IN THE FIELD. HOWEVER THE PHOTO-ESTIMATION TECHNIQUE IS NOT CAPABLE OF DETERMINING THE MEAN VOID WIDTH FOR VERY SMOOTH PAVEMENTS. STUDIES PERFORMED TO DETERMINE HOW RELIABLY A NUMBER OF RATERS COULD RATE PAVEMENT MOLDS AND PHOTOS SO THAT STANDARDS COULD BE DEVELOPED FOR THE INDIVIDUAL CLASSES OF PAVEMENT TEXTURE RESULTED IN A PEARSON CORRELATION COEFFICIENT BETWEEN ESTIMATED AND KNOWN GRADIENT AT 0.81, INDICATING HIGH RELIABILITY OF THE TECHNIQUE.

by L. BRUCE MCDONALD; ROBERT R. BLACKBURN;  
DONALD R. KOBETT  
ALLEN CORP., ALEXANDRIA, VA.; MIDWEST RES.  
INST., KANSAS CITY, MO.; BLACK AND VEATCH  
ENGINEERS, KANSAS CITY, MO.  
Publ: HS-022 760 (TRR-633), "PAVEMENT SURFACE  
PROPERTIES AND PERFORMANCE," WASHINGTON,  
D.C., 1977 P13-21  
1977; 6REFS  
SPONSORED BY FEDERAL HWY. ADMINISTRATION.  
Availability: IN HS-022 760

HS-022 764

## RELATION OF ACCIDENTS AND PAVEMENT FRICTION ON RURAL, TWO-LANE ROADS

FRICTION MEASUREMENTS WERE MADE WITH A SKID TRAILER AT 40 MILES PER HOUR ON 1460 MILES OF RURAL, TWO-LANE ROADS IN KENTUCKY. MAINTENANCE SECTIONS OR SUBSECTIONS WERE TREATED AS TEST SECTIONS. ACCIDENT EXPERIENCE, FRICTION MEASUREMENTS, TRAFFIC VOLUMES, AND OTHER AVAILABLE DATA WERE OBTAINED FOR EACH SECTION. VARIOUS EXPRESSIONS OF WET-PAVEMENT ACCIDENTS AND PAVEMENT FRICTION WERE RELATED AND ANALYZED. AVERAGING METHODS WERE USED IN DEVELOPING TRENDS AND MINIMIZING SCATTER. A MOVING AVERAGE FOR PROGRESSIVELY ORDERED SETS OF TEN TEST SECTIONS AND TEST SECTIONS GROUPED BY SKID NUMBERS AND PEAK SLIP NUMBERS YIELDED MORE DEFINITE RESULTS. THE EXPRESSION OF ACCIDENT OCCURRENCE THAT CORRELATED BEST WITH SKID RESISTANCE AND PEAK SLIP RESISTANCE WAS RATIO OF WET-PAVEMENT TO DRY-PAVEMENT ACCIDENTS. WET-PAVEMENT TO DRY-PAVEMENT ACCIDENT RATIOS INCREASED GREATLY AS SKID NUMBER DECREASED FROM APPROXIMATELY 40 AND AS PEAK SLIP NUMBER DECREASED FROM APPROXIMATELY 71.

by ROLANDS L. RIZENBERGS; JAMES L. BURCHETT; LARRY A. WARREN  
KENTUCKY DEPT. OF TRANSPORTATION, DIV. OF RES.

Publ: HS-022 760 (TRR-633), "PAVEMENT SURFACE PROPERTIES AND PERFORMANCE," WASHINGTON, D.C., 1977 P21-7  
1977; 4REFS

Availability: IN HS-022 760

HS-022 765

## CRITIQUE OF TENTATIVE SKID-RESISTANCE GUIDELINES

SEVERAL REPORTED ACCIDENT AND DRIVER BEHAVIOR STUDIES RELATED TO SKID RESISTANCE ARE CRITIQUED IN ORDER TO DETERMINE THE MOST REASONABLE TENTATIVE GUIDELINES FOR USE IN VIRGINIA. A REVIEW OF SIX STUDIES CONDUCTED IN VIRGINIA, TEXAS, TENNESSEE, KENTUCKY, ARIZONA, AND GREAT BRITAIN CONFIRMED THE BELIEF THAT REQUIRED SN40 (MINIMUM SKID RESISTANCE) VALUES VARY WITH ROADWAY AND TRAFFIC CONDITIONS AND THAT MUCH WORK REMAINS TO BE DONE REGARDING THE DETERMINATION OF REQUIRED SN40 VALUES FOR SPECIFIC ROADWAY AND TRAFFIC CHARACTERISTICS. ACCIDENT DATA SHOULD CONTINUE TO BE THE PRIMARY BASIS IN VIRGINIA FOR IDENTIFYING WET-PAVEMENT SITES THAT HAVE HIGH ACCIDENT RATES. HOWEVER, GENERAL SN40 GUIDELINES WERE SELECTED FOR THE PURPOSE OF DETERMINING POTENTIALLY HAZARDOUS WET-PAVEMENT ACCIDENT SITES, THAT IS, SITES WITH SN40 VALUES BELOW THE GUIDELINE VALUES. SITES SELECTED IN THIS MANNER WILL BE INCLUDED IN THE NORMAL SITE REVIEW PROCESS OF

THE PROGRAM TO REDUCE WET-PAVEMENT ACCIDENTS AND MAY OR MAY NOT BE TREATED, DEPENDING ON THE RESULTS OF THE REVIEW PROCESS. THE TENTATIVE SN40 GUIDELINES SELECTED AND STATED IN TERMS OF VIRGINIA'S SURVEY OF LOCKED-WHEEL-TRAILER VALUES ARE 30 FOR INTERSTATE AND OTHER DIVIDED HIGHWAYS AND 40 FOR TWO-LANE HIGHWAYS.

by STEPHEN N. RUNKLE; DAVID C. MAHONE  
VIRGINIA HWY. AND TRANSPORTATION RES. COUNCIL, CHARLOTTESVILLE, VA.  
Publ: HS-022 760 (TRR-633), "PAVEMENT SURFACE PROPERTIES AND PERFORMANCE," WASHINGTON, D.C., 1977 P28-34  
1977; 19REFS

Availability: IN HS-022 760

HS-022 766

## WISCONSIN PEDESTRIAN AND BICYCLE SAFETY PLAN

SEVEN SPECIFIC URBAN PEDESTRIAN ACCIDENT TYPES ARE IDENTIFIED AT THE NATIONAL LEVEL, AND WISCONSIN PEDESTRIAN ACCIDENTS ARE CATEGORIZED AS TO LOCATION, VISIBILITY CONDITIONS, AND AGE OF PEDESTRIAN AND DRIVER. RESULTS OF A 1975 WISCONSIN SURVEY ARE PRESENTED SEPARATELY FOR PEDESTRIAN AND BICYCLE ACCIDENTS. ELEMENTS IN PEDESTRIAN SAFETY INCLUDE THE PEDESTRIAN, THE DRIVER OF THE MOTOR VEHICLE, AND CONDITION OF THE WALKWAY. ELEMENTS OF PEDESTRIAN SAFETY PROGRAM EFFECTIVENESS INCLUDE THE QUALITY OF THE PROGRAM AND ITS CARRYOVER INTO THE ACTUAL ON-ROAD TRAFFIC ENVIRONMENT, THE INSTRUCTOR'S COMPETENCY, THE DESIGN, CONSTRUCTION, AND MAINTENANCE OF WALKWAYS, AVAILABILITY OF GOOD STATISTICS AND RECORDS, AND ENFORCEMENT OF PEDESTRIAN REGULATIONS. COORDINATION OF A SAFETY PLAN AT ALL LEVELS IS ESSENTIAL. FACTORS IN BICYCLE ACCIDENTS ARE ANALYZED ON THE NATIONAL LEVEL AND ON THE STATE (WIS.) LEVEL. NATIONALLY, THE BICYCLIST AND/OR THE BICYCLE WAS JUDGED PROBABLY RESPONSIBLE FOR MORE THAN THREE QUARTERS OF BICYCLE/MOTOR VEHICLE COLLISIONS, CYCLIST RESPONSIBILITY BEING STRONGLY RELATED TO AGE. THE YOUNGER (UP TO AGE 12) BICYCLISTS WERE JUDGED PROBABLY RESPONSIBLE IN 90% OF THE COLLISIONS. WISCONSIN BICYCLE ACCIDENTS ARE CATEGORIZED IN THE SAME MANNER AS PEDESTRIAN ACCIDENTS. ELEMENTS IN BICYCLE SAFETY INCLUDE THE DRIVERS OF THE BICYCLE AND THE MOTOR VEHICLE, THE CONDITION OF THEIR VEHICLES, THE QUALITY OF SAFETY EDUCATION AND OF LAW ENFORCEMENT PROGRAMS, AND THE ENGINEERING ASPECTS OF BICYCLE WAYS AND ROADWAYS. COORDINATION IS ESSENTIAL FOR THE VARIOUS AGENCIES AND GROUPS INVOLVED IN IMPLEMENTATION OF THE RECOMMENDED BICYCLE SAFETY PLAN, FROM THE STATE LEVEL THROUGH THE COUNTY TO THE LOCAL LEVEL, INCLUDING SCHOOLS, POLICE DEPARTMENTS, AND CIVIC/SERVICE ORGANIZATIONS. COOPERATION IS URGED BY PARENTS, BY CITY ENGINEERS, AND BY PARKS AND RECREATION DE-

PARTMENTS, AS WELL AS BY BICYCLE DEALERS AND BICYCLE CLUBS, BY INDUSTRY, AND BY THE MEDIA. STATISTICAL TABLES ARE PROVIDED FOR WISCONSIN BICYCLE AND PEDESTRIAN ACCIDENTS, AS ARE COPIES OF SURVEY FORMS FOR LAW ENFORCEMENT AGENCIES, SCHOOL DISTRICTS, STATE ORGANIZATIONS, TRAFFIC SAFETY COMMISSIONS, AND BICYCLE CLUBS.

by RONALD L. THOMPSON  
UNIVERSITY OF WISCONSIN-WHITEWATER, DEPT. OF SAFETY EDUCATION  
1976; 180P  
DEVELOPED UNDER PROVISIONS OF PROJECT 99-17(010)01-75.  
Availability: STATE OF WISCONSIN, DIV. OF HWY. SAFETY COORDINATION, SUITE 803, JAMES WILSON PLAZA, 131 W. WILSON ST., MADISON, WIS. 53702

HS-022 767

### **UPGRADING SAFETY PERFORMANCE IN RETROFITTING TRAFFIC RAILING SYSTEMS. FINAL REPORT**

FROM BRIDGE RAIL INFORMATION OF 51 STATE HIGHWAY AGENCIES AND PERSONAL INTERVIEWS WITH FIVE SELECTED HIGHWAY AGENCIES, CURRENT STATE-OF-THE-ART OF BRIDGE RAILING SAFETY PERFORMANCE WAS ASSESSED. BASED ON THE ANALYSIS OF 14 SPECIFIC RAILING DESIGNS, AN ESTIMATED ASSESSMENT OF THE PERFORMANCE OF BRIDGE RAILS ON A NATIONAL SCALE IS PRESENTED. THE DATA INDICATE THAT A SIGNIFICANT PERCENTAGE OF EXISTING RAILINGS MAY BE BELOW CURRENTLY ATTAINABLE SAFETY PERFORMANCE STANDARDS. BRIDGE RAILING DESIGNS ARE GROUPED INTO FOUR CATEGORIES ACCORDING TO PROFILE GEOMETRY AND FEATURES THAT ARE AMENABLE TO A COMMON RETROFIT DESIGN. TWO CATEGORIES, II AND III, REPRESENT ABOUT 82% OF EXISTING INSTALLATIONS. FIVE RETROFIT DESIGNS FOR CATEGORIES II AND III WERE DEVELOPED AND EVALUATED BY A 22-CRASH TEST PROGRAM. ALTHOUGH NOT CRASH-TEST EVALUATED, AN IMPROVED APPROACH TO GUARDRAIL DESIGN FEATURES A THREE BEAM RAIL ELEMENT AND A BREAKAWAY CABLE TERMINAL. APPENDED ARE DRAWINGS, CRASH TEST PROCEDURES AND TEST DATA, AND SIMULATION STUDIES OF THE EFFECTS OF CURB GEOMETRY ON VEHICLE REDIRECTION.

by JARVIS D. MICHIE; MAURICE E. BRONSTAD  
SOUTHWEST RES. INST., 8500 CULEBRA RD., SAN ANTONIO, TEX. 78284  
DOT-FH-11-8100  
Rept. No. FHWA-RD-77-40; [SRI] 03-3717; 1976; 277P  
20REFS  
REPT. FOR 1 JUL 1973-1 JUN 1976.  
Availability: NTIS

HS-022 768

### **MODEL PROGRAMS IN PEDESTRIAN AND BICYCLE SAFETY FOR WISCONSIN COMMUNITIES**

A GUIDE TO MODEL PROGRAMS IN PEDESTRIAN AND BICYCLE SAFETY IS INTENDED FOR USE BY WISCONSIN COMMUNITIES AS AN AID IN PROGRAM ESTABLISHMENT. A SECTION ON ORGANIZING FOR SAFETY DETAILS COMMUNITY SAFETY ORGANIZATION, ACCIDENT RECORDS SYSTEMS, RETROREFLECTIVE MATERIALS, AND USEFUL MOTOR VEHICLE OPERATOR PRACTICES IN REGARD TO BICYCLISTS AND PEDESTRIANS. GUIDELINES ON PEDESTRIAN PROGRAMS INCLUDE A SUGGESTED ORDINANCE, PEDESTRIAN ACCIDENT FACTS, AND SUGGESTED SAFETY RULES FOR PEDESTRIANS, INCLUDING SPECIFICS FOR OLDER ADULTS. OTHER PEDESTRIAN PROGRAM SUGGESTIONS INCLUDE ENGINEERING FOR SAFETY, DELINEATION OF SAFEST ROUTES, SAFETY TOWN PROGRAMS FOR YOUNG CHILDREN, AND THE HELPING HAND PROGRAM DESIGNED TO HELP THE CHILD TO BETTER PROTECT HIMSELF AS A PEDESTRIAN. A SECTION ON BICYCLE PROGRAMS INCLUDES SUGGESTED BICYCLE ORDINANCE, BICYCLE ACCIDENT FACTS, TYPES OF BICYCLES, AND GENERAL SAFETY RULES. ALSO DETAILED ARE SIGNS AND SIGNALS FOR BICYCLE DRIVERS, SELECTION, EQUIPMENT, AND MAINTENANCE, A SUGGESTED REGISTRATION AND LICENSING PROGRAM, AND A BICYCLE SKILLS TEST. INFORMATION IS PROVIDED ON BICYCLE RODEOS, BICYCLE COURT, LANES, PATHS, AND ROUTES, AND A BICYCLE LOCK-UP CAMPAIGN. APPENDICES INCLUDE A LISTING OF BOOKLETS, PAMPHLETS, AND MANUALS, AND AN EVALUATION FORM FOR THE PROGRAM GUIDE.

by RONALD L. THOMPSON  
GOVERNOR'S OFFICE OF HWY. SAFETY, DIV. OF HWY. SAFETY COORDINATION, SUITE 803, JAMES WILSON PLAZA, 131 W. WILSON ST., MADISON, WIS. 53702; 103P 89REFS  
Availability: CORPORATE AUTHOR

HS-022 769

### **THE EFFECTS OF THE AUTO FUEL ECONOMY PROVISIONS OF THE ENERGY POLICY AND CONSERVATION ACT AND RELATED PROPOSALS**

THE PROJECTED IMPACT IS EVALUATED OF THE ENERGY POLICY AND CONSERVATION ACT ON FUTURE AUTO SALES, OWNERSHIP, USE, AND FUEL CONSUMPTION. AN ECONOMETRIC MODEL IS APPLIED TO MAKE PROJECTIONS OF AUTO SALES, USE, AND FUEL CONSUMPTION IN ORDER TO COMPARE THE IMPACTS OF ALTERNATIVE POLICIES AND ASSUMPTIONS IN FUTURE YEARS. EIGHT ALTERNATIVE CASES ARE EXAMINED TO ESTIMATE HOW THE MARKET WILL RESPOND TO DIFFERENT MOTOR VEHICLE MANUFACTURER OFFERINGS; AND HOW MOTOR VEHICLE PRODUCERS WILL ADAPT THEIR TECHNOLOGIES AND PRICING PATTERNS TO RESPOND TO DIFFERENT FEDERAL POLICIES RELATED TO NEW CAR FUEL ECONOMY. THE AUTO SECTOR FORECASTING (ASF) MODEL USED IN THIS STUDY WAS DESIGNED SPECIFICALLY TO PREDICT

THE EFFECTS OF ALTERNATIVE AUTOMOBILE FUEL ECONOMY POLICIES. ALTERNATIVES INVESTIGATED INCLUDE A BASELINE; 35% DIESEL MARKET PENETRATION IN 1985; CONSTRAINED SALES AND MARKET SHARES; AND A DOUBLING OF STATUTORY PENALTIES UNDER THE ENERGY POLICY AND CONSERVATION ACT. OTHER ALTERNATIVES ARE FEDERAL REBATES AND EXCISE TAXES TO ENHANCE THE ACT'S EFFECTIVENESS; DECONTROL OF DOMESTIC CRUDE OIL PRICES; INCREASE OF 25 CENTS PER GALLON IN THE FEDERAL GASOLINE TAX; AND THE ABSENCE OF AN ENFORCED FEDERAL NEW CAR FUEL ECONOMY POLICY. PRINCIPAL FINDINGS INDICATE THAT IF AUTOMOBILE MANUFACTURERS MAKE ASSUMED TECHNOLOGICAL CHANGES, AUTO FUEL CONSUMPTION CAN BE CUT BY 5% BY 1985 AND FUEL ECONOMY FOR MODEL YEAR 1985 CAN BE INCREASED BY MORE THAN 15%. WITHOUT ADDITIONAL FUEL ECONOMY INCENTIVES MODEL YEAR 1985 SALES-WEIGHTED FUEL ECONOMY WILL FALL AROUND 26.6 MILES PER GALLON. AN INCREASE OF 25 CENTS PER GALLON IN THE GASOLINE TAX YIELDS 1985 FUEL CONSUMPTION 6% BENEATH THAT PROJECTED FOR THE ENERGY POLICY AND CONSERVATION ACT ALONE, BUT IT ALSO YIELDS AUTO SALES 5.8% LOWER AND VEHICLE MILES OF TRAVEL 5.4% LOWER. THE IMPOSITION OF ADDITIONAL FEDERAL INCENTIVES APPEARS TO AID FUEL CONSERVATION WHILE HAVING ONLY VERY MINOR EFFECTS ON AUTO SALES, OWNERSHIP, AND TRAVEL. AN APPENDIX TABULATES DETAILED PROJECTIONS.

JACK FAUCETT ASSOCIATES, INC., 5454 WISCONSIN AVE., CHEVY CHASE, MD. 20015  
Rept. No. JACKFAU-77-180-1; 1977; 50P 16REFS  
Availability: CENTER FOR AUTO SAFETY, ROOM 1223, 1346 CONNECTICUT AVE., N.W., WASHINGTON, D.C. 20036 \$11.00

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### THE RELATIONSHIP OF HEMODYNAMICS TO SEATING COMFORT

A RELATIONSHIP OF SELECTED HEMODYNAMIC FUNCTIONS TO SUBJECTIVE'S SEATING COMFORT EVALUATIONS HAS BEEN OBSERVED. STUDIES WERE CONDUCTED USING RATING SCALES, SUBJECTIVE PROBABILITIES, ADJECTIVE CHECKLISTS, AND CONCURRENT MEASURES OF HEMODYNAMICS VARIATIONS WITH A REPRESENTATIVE DRIVER POPULATION TO DEVELOP RELIABLE PSYCHOPHYSIOLOGICAL INDICES OF COMFORT. THIRTY-TWO VARIABLES CONSTITUTED THE DATA BANK SUBJECTED TO MULTIVARIATE CANONICAL CORRELATION ANALYSES. SUBJECTIVE DATA WERE COMPOSED WITH PHYSIOLOGICAL DATA AND SAE SEAT DIMENSIONS. SIGNIFICANT RELATIONSHIPS AMONG SUBJECTIVE AND PHYSIOLOGIC MEASURES WERE FOUND. THE REDISTRIBUTION OF BLOOD FROM THE CENTRAL POOL WAS FOUND TO BE ASSOCIATED WITH THE ABSENCE OF SUBJECTIVE COMFORT. THE STATIC UPRIGHT SITTING POSTURE CAN OBVIOUSLY AFFECT DRIVER PERFORMANCE. THE LACK OF ADEQUATE BACK SUPPORT AND DEEP POCKETING CUSHIONS TEND TO INDUCE A

SLOUCHED SITTING POSTURE REDUCING OVERALL COMFORT AND FURTHER ADDING TO NATURAL HEMODYNAMIC VARIABILITY. IT IS RECOMMENDED THAT OCCUPANTS OF VEHICLES USE MUSCLE CONTRACTION OR ISOMETRIC EXERCISE, ESPECIALLY OF THE LOWER EXTREMITIES, AS A DETERRENT TO THE EARLY ONSET OF DISCOMFORT AND FATIGUE.

by EDMUND J. GLASSFORD  
Rept. No. SAE-770248; 1977; 7P 10REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION, DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 772

### ENERGY ABSORBING BUMPERS FOR TRANSIT BUSES: TRANSBUS PROGRAM. TECHNICAL REPORT

RESULTS ARE DESCRIBED OF A PROGRAM TO TEST AND EVALUATE THE POTENTIAL BENEFITS OF ENERGY ABSORBING BUMPERS FOR TRANSIT BUSES. THE OBJECTIVE OF THE PROGRAM IS TO DETERMINE, THROUGH CONTROLLED TESTS, THE CAPABILITIES/LIMITATIONS OF SIX NEW DESIGNS OF ENERGY-ABSORBING BUMPER SYSTEMS. PRINCIPAL EMPHASIS IS PLACED UPON THE BUMPER SYSTEM PERFORMANCE UNDER SIMULATED IN-SERVICE TESTS WITH RESPECT TO ITS EFFECTIVENESS IN PROTECTING THE BUS FROM MINOR ACCIDENT HAZARDS ENCOUNTERED DURING REVENUE SERVICE. THE ECONOMIC BENEFITS OF ENERGY-ABSORBING BUMPERS ARE DISCUSSED WITH RESPECT TO LOWERED LIFE-CYCLE ACCIDENT COSTS. TEST FACILITIES, EACH TYPE OF BUMPER SYSTEM TESTED, AND TEST PROCEDURES ARE DETAILED IN TERMS OF TEST OBJECTIVES, EQUIPMENT AND METHODOLOGY, AND FUNCTIONAL DESCRIPTIONS OF EACH BUMPER SYSTEM. TEST RESULTS, PRESENTED IN TABULAR FORM, INDICATE ENERGY-ABSORBING PERFORMANCE AT VARIOUS IMPACT VELOCITIES, MAXIMUM IMPACT CAPABILITY, AND OTHER ATTENDANT CHARACTERISTICS. IN FRONTAL IMPACTS WITH A SIMULATED 4000 POUND AUTOMOBILE, ALL BUMPERS CONTINUED TO ABSORB ENERGY FOR SPEEDS UP TO 6.07 MPH. A 30,000 POUND BUS FITTED WITH PROTECTIVE BUMPERS WOULD PROBABLY BE UNDAMAGED WHEN SUBJECTED TO A 5 MPH FLAT-BARRIER IMPACT; A HEAD-ON COLLISION WITH A PASSENGER CAR MOVING AT 8 MPH TO 10 MPH; OR A REAR IMPACT BY A PASSENGER CAR AT 8 MPH TO 10 MPH. NO SIGNIFICANT DAMAGE SHOULD OCCUR TO A 1974-MODEL OR LATER-MODEL PASSENGER CAR WHEN INVOLVED IN 8-MPH TO 10-MPH IMPACTS IF THE CAR IS EQUIPPED WITH ENERGY-ABSORBING BUMPERS. BEYOND 8-MPH TO 10-MPH THE STRUCTURAL CHARACTERISTICS OF THE VEHICLES WILL DETERMINE THE POINT AT WHICH SIGNIFICANT DAMAGE WILL OCCUR. TESTS RESULTS INDICATE THAT ALL BUMPERS EXCEPT THE BASELINE CURRENT PRODUCTION BUS BUMPER EXHIBIT EFFECTIVE ENERGY-ABSORBING CHARACTERISTICS UNDER PENDULUM TEST CONDITIONS ESTABLISHED UNDER FEDERAL MOTOR VEHICLE SAFETY STANDARD (FMVSS) 215. SPECIFIC RECOM-



MENDATIONS CENTER ON IMPACT ABSORBING CAPABILITY; REBOUND, PEDESTRIAN PROTECTION, READINESS, MAINTAINABILITY, RELIABILITY, AND SAFETY CHARACTERISTICS.

BOOZ, ALLEN APPLIED RES., 4733 BETHESDA AVE., BETHESDA, MD. 20014  
DOT-UT-10008  
Rept. No. UMTA-IT-06-0025-77-4; PB-269 405; TR-76-003; 1976; 49P 10REFS  
REPT. FOR SEP 1973-NOV 1976.  
Availability: NTIS

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### **DRINKING DRIVERS IN CANADA. A NATIONAL ROADSIDE SURVEY OF THE BLOOD ALCOHOL CONCENTRATIONS [BAC] IN NIGHTTIME CANADIAN DRIVERS**

A SURVEY WAS CONDUCTED IN TEN CANADIAN PROVINCES, IN THE SPRING AND FALL SEASONS OF 1974, EACH WEDNESDAY, THURSDAY, FRIDAY, AND SATURDAY FOR 12 WEEKS, DURING WHICH 9700 DRIVERS WERE STOPPED BETWEEN 10 P.M. AND 3 A.M. AT 585 RANDOMLY SELECTED SITES. EACH DRIVER WAS ASKED TO PROVIDE A BREATH SAMPLE AND INFORMATION ON DRINKING AND DRIVING HABITS, TRIP LENGTH, AND BASIC DEMOGRAPHIC CHARACTERISTICS. ROAD CONDITIONS, WEATHER, SPEED LIMITS, AND USE OF SEAT BELTS WERE RECORDED. THE SURVEY METHODOLOGY, THE SAMPLING AND ANALYSIS PROCEDURES, AND THE RELATIONSHIPS BETWEEN BAC AND DEMOGRAPHIC, DRIVING, AND DRINKING VARIABLES ARE PRESENTED. THE EXTENT AND NATURE OF THE DRINKING-DRIVING PROBLEM IN CANADA ARE EXAMINED AND FUTURE USE OF THESE DATA PROJECTED IN MONITORING THE EFFECTIVENESS OF FUTURE COUNTERMEASURE ACTIVITIES. THE PROPORTION OF DRINKING DRIVERS MORE THAN DOUBLED BETWEEN THE 10 P.M. TO MIDNIGHT AND THE 1 A.M. TO 3 A.M. PERIODS. THE LARGEST PROPORTION OF SUCH DRIVERS WAS OBSERVED ON SATURDAY EVENING. THE DRINKING PROBLEM WAS AS SERIOUS ON THURSDAY AS ON FRIDAY. PERCENTAGES OF DRINKING AND IMPAIRED DRIVERS WERE HIGHEST IN BRITISH COLUMBIA AND LOWEST IN THE ATLANTIC REGION. DEMOGRAPHIC CHARACTERISTICS OF THE DRINKING DRIVER INCLUDED THE FOLLOWING: MALE, MIDDLE-AGED, UNEMPLOYED OR EMPLOYED AT A LOW ECONOMIC LEVEL, AND SEPARATED AND DIVORCED. DRINKING/DRIVING BEHAVIOR DID NOT APPEAR TO BE INFLUENCED BY EXTERNAL HAZARDS. THE DATA REVEALED MARKED SIMILARITIES WITH DATA FROM OTHER COUNTRIES INCLUDING THE U.S. AND THE NETHERLANDS. THE ROADSIDE SURVEY PROVED TO BE A VIABLE STUDY TOOL AND HAS PROVIDED A STATISTICALLY SOUND DATA BASE FOR FURTHER RESEARCH.

by G. A. SMITH; M. S. WOLYNETZ; T. R. I. WIGGINS  
TRANSPORT CANADA, ROAD AND MOTOR VEHICLE TRAFFIC SAFETY BRANCH, OTTAWA, ONT., CANADA  
Rept. No. TP-1311; 1976; 106P 21REFS  
COVER TITLE: "1974 NATIONAL ROADSIDE SURVEY. BAC OF NIGHTTIME [SIC] CANADIAN DRIVERS."  
Availability: CORPORATE AUTHOR

HS-022 774

### **WHAT REALLY CONNECTS IN SEATING COMFORT? STUDIES OF CORRELATES OF STATIC SEAT COMFORT**

EVALUATIONS OF 20 SEATING ENVIRONMENTS WERE CONDUCTED USING RATING SCALES, SUBJECTIVE PROBABILITIES, AND ADJECTIVE CHECKLISTS WITH A REPRESENTATIVE DRIVER POPULATION TO DEVELOP RELIABLE INDICES OF PSYCHOLOGICAL SEATING COMFORT. CONCURRENT MEASURABLE PHYSIOLOGIC VARIATIONS WERE ALSO RECORDED TO DETERMINE RELATIONSHIP PATTERNS. PRIMARY PSYCHOLOGICAL DESCRIPTORS WERE IDENTIFIED FOR EACH SEATING ENVIRONMENT. SUBJECTIVE DATA WERE COMPARED WITH PHYSIOLOGICAL DATA AND SAE SEAT DIMENSIONING FINDINGS. MULTIVARIATE CANONICAL CORRELATION ANALYSES OF 32 VARIABLES ARE REPORTED, AS ARE SUBJECTIVE PROFILES FOR EACH SEATING ENVIRONMENT. RESULTS SUGGEST THAT SEATING COMFORT IS MORE THAN A UNITARY CONCEPT. OVERALL COMFORT, COMFORTABLE, AND ACCOMMODATING JUDGMENTS WERE ASSOCIATED IN THE STRONGEST RELATIONSHIP COMBINATION. LOW TOTAL SEGMENTAL ACCUMULATION, A PHYSIOLOGICAL MEASURE, WAS SIGNIFICANTLY ASSOCIATED WITH JUDGMENTS OF HIGH OVERALL COMFORT. SIGNIFICANT RELATIONSHIPS AMONG SUBJECTIVE AND PHYSIOLOGICAL VARIABLES IN THE EVALUATION OF SEATING ENVIRONMENTS WERE FOUND. AN APPENDIX PRESENTS SUBJECTIVE QUESTIONNAIRES.

by STEFAN HABSURG; LORNA MIDDENDORF  
GENERAL MOTORS CORP., DESIGN STAFF  
Rept. No. SAE-770247; 1977; 54P 6REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION, DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 775

### **THE EFFECTS OF MANDATORY SCHOOL-ENTRANCE MARKINGS**

AN EXPERIMENT HAS BEEN CARRIED OUT AT A NUMBER OF SCHOOLS IN THE GREATER LONDON, ENGLAND, AREA TO ASSESS THE EFFECTS THAT MANDATORY SCHOOL ENTRANCE MARKINGS WHICH PROHIBIT STOPPING WOULD HAVE ON PARKING AND SAFETY. THE FIRST PHASE CONSISTED OF EIGHT SCHOOLS WHERE THE ENTRANCE MARKINGS HAD RECENTLY BEEN CONVERTED FROM WHITE BOX OR ZIGZAG MARKINGS TO MANDATORY YELLOW ZIGZAG MARKINGS. THE SECOND EXPERIMENTAL PHASE FOCUSED ON SEVEN SCHOOLS WHERE MANDATORY YELLOW ZIGZAG MARKINGS HAD RECENTLY REPLACED WHITE ZIGZAGS. THE THIRD PHASE INVOLVED FIVE SCHOOLS WHERE ENTRANCE MARKINGS WERE CONVERTED TO NON-MANDATORY YELLOW ZIGZAG MARKINGS. CURBSIDE SIGNS WERE ERECTED AT EACH SITE TO INDICATE THE NATURE OF THE RESTRICTION. AT EACH SITE, SIX WEEKDAY SURVEYS WERE CARRIED OUT BOTH BEFORE AND AFTER IMPLEMENTATION



OF NEW MARKINGS. ANALYSIS OF PARKING DATA INDICATES THAT FOR ALL THREE PHASES THERE WERE REDUCTIONS IN THE NUMBER OF STATIONARY VEHICLES AFTER THE INTRODUCTION OF YELLOW MARKINGS. THE NONMANDATORY MARKINGS WERE MORE SUCCESSFUL THAN THE MANDATORY MARKINGS. IN ALL THREE PHASES THE GREATEST NUMBER OF STATIONARY VEHICLES AT ANY TIME WERE CARS. HOWEVER, THIS CLASS SHOWED THE GREATEST REDUCTION BOTH IN TERMS OF NUMBERS AND PERCENTAGE CHANGES IN BEFORE AND AFTER COMPARISONS. ALTHOUGH PHASE I SITES HAD THE GREATEST IMPACT, SOME OF THE REDUCTION ACHIEVED CAN BE ATTRIBUTED TO THE ADDED EFFECTS OF CONVERTING FROM BOX MARKINGS. THE OVERALL ACCIDENT RATE OUTSIDE SCHOOL ENTRANCES IS LOW (ONE ACCIDENT IN NINE YEARS ON AVERAGE) AND THE INVOLVEMENT OF PARKED VEHICLES VERY LOW (ONE ACCIDENT IN 38 YEARS). COUPLED WITH THE LACK OF IMPACT OF MANDATORY MARKINGS FOUND IN PHASE II, THIS SUGGESTS THAT THE CASE FOR MANDATORY SIGNS AND MARKINGS MUST REST ONLY ON THE SUBJECTIVE VIEWS PRESENTED BY LOCAL GROUPS.

by D. J. BROWNFIELD  
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(FEB 1978)  
1978; 1REF  
Availability: SEE PUBLICATION

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#### **FIRE DATA METHODOLOGY: VOL. 1. NATIONAL ESTIMATES OF FIRE INJURIES. FINAL REPORT**

SEVERAL SOURCES OF INJURY DATA ARE EVALUATED FOR USEFULNESS IN ESTIMATING THE TOTAL NUMBER OF FIRE INJURIES IN THE U.S. FOR 1975, INCLUDING NATIONAL SAMPLES OF HOSPITAL DISCHARGE RECORDS, BURN REGISTRY INFORMATION, EMERGENCY ROOM VISITS, DEATH CERTIFICATES, FIRE DEPARTMENT RECORDS, AND OTHER SPECIALIZED SOURCES. SERIOUS PROBLEMS EXIST IN DATA SOURCES IN THAT INFORMATION IS INSUFFICIENT IN NATIONAL SAMPLES TO IDENTIFY INJURIES CAUSED BY FIRES, AND DIFFERENT DATA SOURCES DEFINE AND REPORT INJURIES DIFFERENTLY. THEREFORE INDIRECT METHODS OF ESTIMATION WERE DEVELOPED TO IDENTIFY FIRE-CAUSED INJURIES. A COMBINED ESTIMATE OF THE NUMBER OF PERSONS INJURED FROM FIRES IS PRESENTED. FOR THE U.S. IN 1975 IT IS ESTIMATED THAT 7300 PERSONS DIED FROM FIRES, WHILE AN ESTIMATED 52,400 PERSONS WERE HOSPITALIZED FOR INJURIES WHICH RESULTED FROM FIRES. A RANGE OF FROM 225,000 TO 400,000 PERSONS RECEIVED OTHER INJURIES FROM FIRES, DEPENDING ON THE DEFINITION OF WHAT THRESHOLD IS USED TO DEFINE NONHOSPITALIZED INJURIES. DATA FROM THE STATE OF MICHIGAN AND FROM A NATIONAL SAMPLE OF EMERGENCY ROOM RECORDS ARE ALSO ANALYZED TO RELATE TO THE FIRE INJURIES SUCH FACTORS AS AGE, TIME OF DAY, TYPE OF INJURY, SEX, AND SOURCE OF IGNITION. THE SIMPLEST AND MOST COST-EFFECTIVE ACTION

WHICH COULD BE TAKEN TO IMPROVE INFORMATION AVAILABLE ABOUT FIRE-CAUSED INJURIES IN THE U.S. WOULD BE TO INCLUDE TWO ADDITIONAL DATA ITEMS IN THE HOSPITAL RECORD: THE CAUSE OF INJURY, AND SOURCE OF INFORMATION. AN APPENDIX DETAILS METHODS OF COMBINING DATA FROM DIFFERENT STUDIES.

by JAIROS D. FLORA, JR.; LILY CH. HUANG; LARRY D. ROI; PETER COOLEY  
UNIVERSITY OF MICHIGAN, HWY. SAFETY RES.  
INST., ANN ARBOR, MICH. 48109  
Rept. No. UM-HSRI-77-36-1; 1977; 84P 23REFS  
Availability: CORPORATE AUTHOR

HS-022 778

#### **THE INTERACTION BETWEEN DRIVER MENTAL AND PHYSICAL CONDITIONS AND ERRORS CAUSING TRAFFIC ACCIDENTS: AN ANALYTICAL APPROACH**

AN ANALYTICAL METHODOLOGY WAS DEVELOPED TO STUDY THE RELATIONSHIPS BETWEEN DRIVER BEHAVIORS CAUSING AND IMMEDIATELY PRECEDING AN ACCIDENT (DIRECT CAUSES), AND ACCIDENT CAUSAL IMPAIRMENTS IN DRIVERS' PREDISPOSING MENTAL AND PHYSICAL STATES (INDIRECT CAUSES). A STATISTIC DEFINED AS THE RELATIVE INVOLVEMENT FACTOR (RIF) WAS DEVELOPED TO REFLECT THE CHANGE IN THE LIKELIHOOD OF ANY DIRECT ACCIDENT-CAUSING BEHAVIOR BEING IMPLICATED GIVEN THE EXISTENCE OF A CAUSALLY RELEVANT MENTAL OR PHYSICAL IMPAIRMENT. THE USEFULNESS OF THE RIF WAS DEMONSTRATED IN AN ANALYSIS OF 420 TRAFFIC ACCIDENTS. THE SAMPLE WAS CHOSEN FROM MONROE COUNTY, IND. ACCIDENT STATISTICS TO BE REPRESENTATIVE WITH RESPECT TO WEATHER CONDITIONS, ROAD CONFIGURATION AND SURFACE CONDITIONS, AND DRIVER AGE AND SEX. THE ANALYSIS INDICATED THAT CAUSAL CONDITIONS AND STATES SUPPRESS CERTAIN DIRECT CAUSES WHILE INCREASING THE LIKELIHOOD OF OTHERS. ALCOHOL IMPAIRMENT APPEARS TO BE DIRECTLY CORRELATED WITH CRITICAL NONPERFORMANCE AS A DIRECT CAUSE. OTHER DRUG IMPAIRMENT, FATIGUE, REDUCED VISION, AND EMOTIONAL UPSET ARE ALSO CLOSELY RELATED TO SUCH DIRECT CAUSES AS CRITICAL NONPERFORMANCE AND VISUAL SEARCH BEHAVIOR. OTHER COMMON RIF'S INCLUDED BEING IN A HURRY, VEHICLE AND AREA UNFAMILIARITY, AND DRIVER INEXPERIENCE.

by DAVID SHINAR; STEPHEN T. MCDONALD; JOHN R. TREAT  
DOT-HS-034-3-535  
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### BICYCLE RIDING PRACTICES: IMPLICATIONS FOR SAFETY CAMPAIGNS

THE RIDING BEHAVIOR OF APPROXIMATELY 2200 BICYCLISTS IN ALBERTA, CANADA, WAS OBSERVED AND RECORDED TO PROVIDE CYCLING STATISTICS AND ACCIDENT FREQUENCY DATA, AND FORMULATION OF BICYCLE SAFETY CAMPAIGNS. FAILURE TO OBEY LAWS AND A GENERAL TENDENCY TOWARD RECKLESS RIDING ARE PROBABLY RELATED TO THE TYPES OF ACCIDENTS THAT OCCUR. RELATIVE RISK INDICES WERE ASSIGNED TO VARIOUS TYPES OF ERRORS RECORDED ON DATA SHEETS. RIDING ERRORS WERE COMMITTED BY 32% OF THE SAMPLE, AND 3% MADE MORE THAN TWO ERRORS. THE MOST FREQUENTLY OCCURRING ERRORS WERE FAILING TO SIGNAL TURNS OR LANE CHANGES; NOT RIDING SINGLE-FILE; FAILING TO LOOK BEHIND WHEN CHANGING LANES; RIDING ON THE WRONG SIDE OF THE ROADWAY; AND NOT HAVING BOTH HANDS ON THE HANDLEBARS. SOME ERRORS WERE FOUND TO BE RELATED TO THE AGE AND SEX OF THE CYCLIST, FOR EXAMPLE, RIDERS UNDER 12 YEARS OLD MORE FREQUENTLY WEAVER DANGEROUSLY; MALE CYCLISTS MADE MORE U-TURNS. THE BICYCLES OBSERVED WERE GENERALLY POORLY EQUIPPED WITH SAFETY DEVICES, WITH 22% HAVING REFLECTORS AND ONLY 5.3% HAVING A LIGHT. THE RELATIONSHIP BETWEEN THE TENDENCY TO MAKE MORE THAN ONE DRIVING ERROR AND AGE INDICATES A GREATER LIKELIHOOD OF ACCIDENTS AMONG YOUNGER CYCLISTS. IN ADDITION, A SURVEY WAS MADE OF TWO SAMPLES OF SUBJECTS AND ALSO SAFETY EXPERTS WHO RATED THE DEGREE OF DANGER OF THE VARIOUS RIDING ERRORS WITH AND WITHOUT MOTOR VEHICLES PRESENT. CLOSE AGREEMENT WAS FOUND AMONG THE THREE INDEPENDENT SAMPLES. THE MOST IMPORTANT TARGET AREA TO ADDRESS IS THE YOUNGER CYCLISTS UNDER 12 YEARS OF AGE. AN EFFECTIVE WAY OF UTILIZING SAFETY INFORMATION WOULD BE TO POINT OUT USING TELEVISION SPOTS HOW AND WHY ERRORS ARE MADE, AND SAFER ALTERNATIVES.

by ROBERT E. DEWAR  
 Publ: JOURNAL OF SAFETY RESEARCH V10 N1 P35-42  
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 FUNDED BY ALBERTA SAFETY COUNCIL.  
 Availability: SEE PUBLICATION

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### SODIUM AZIDE IN AUTOMOTIVE AIR BAGS. DRAFT

SODIUM AZIDE AS AN OXIDIZING AGENT HAS RECENTLY BEEN DEVELOPED AS A PYROTECHNIC MATERIAL FOR USE IN AUTOMOTIVE AIR BAGS. QUESTIONS CONCERNING THE USE OF SODIUM AZIDE HAVE ARISEN, REGARDING ITS KNOWN TOXICITY, OCCUPATIONAL HAZARDS, AND PROBLEMS ASSOCIATED WITH DISPOSAL. TWO FRONT SEAT AIR BAGS GENERALLY CONTAIN LESS THAN ONE POUND OF SODIUM AZIDE, WHICH IS HERMETI-

CALLY SEALED INTO AN ALUMINUM OR PLASTIC CAN. USE OF SODIUM AZIDE IN VEHICLES WITH AIR BAGS IS ALSO RELATIVELY SAFE BECAUSE THE MATERIAL IS BURIED DEEP WITHIN THE STEERING HUB AND INSTRUMENT PANEL. WARNINGS SHOULD BE POSTED ON VEHICLE INFLATORS WHICH CAUTION AGAINST PURPOSELY OPENING THE AIR COMPARTMENT AND EXPOSING THE SODIUM AZIDE. VEHICLE DISPOSAL WOULD CAUSE EXPOSURE TO THE CHEMICAL ONLY IF CARS WERE DISPOSED WITH THEIR AIR BAGS UNINFLATED. IN SHREDDING PROCESSES, WHICH EMPLOY HEAT AND HAMMERS, WOULD AUTOMATICALLY IGNITE AND BURN OFF THE SODIUM AZIDE. ALTHOUGH SODIUM AZIDE IN THE NONFERROUS CONCENTRATE COULD BE EXPOSED TO LEAD, COPPER, ZINC, OR OTHER METALS THAT CAN FORM EXPLOSIVES FROM SODIUM AZIDE, THE CONCENTRATION OF THESE MATERIALS MAKES SIGNIFICANT REACTIONS FORM OTHER METALLIC AZIDES HIGHLY UNLIKELY. REACTION WITH WATER COULD LEAD TO FORMATION OF HYDRAZOIC ACID, BUT THIS IS VIRTUALLY IMPOSSIBLE. THE MAJOR EFFECT OF EXPOSURE TO SODIUM AZIDE IS A PROFOUND LOWERING OF BLOOD PRESSURE. OTHER EFFECTS OF TOXICATION INCLUDE RESPIRATORY ARREST, DEVELOPMENT OF CONVULSIONS (AT FIRST CLONIC, LATER TETANIC), AND FINALLY HEART FAILURE. THE BIOLOGICAL ACTIVITY OF SODIUM AZIDE IN SOIL ARISES FROM LIBERATION OF UNIONIZED HYDRAZOIC ACID. ITS POTENCY AS A MUTAGEN IS COMPARABLE TO THE NITROSAMINES AS A CLASS.

by BRUCE BUCKHEIT; WILLIAM FAN  
 NATIONAL HWY. TRAFFIC SAFETY  
 ADMINISTRATION, WASHINGTON, D.C.  
 1978; 52P 44REFS  
 Availability: CORPORATE AUTHOR

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### ASPECTS OF THE EYEBLINK DURING SIMULATED DRIVING AS A FUNCTION OF ALCOHOL

EYEBLINK FREQUENCY AND CLOSURE DURATION WERE RECORDED WHILE 20 SUBJECTS OPERATED A DRIVER SIMULATOR AS THEY VIEWED TWO FILMS UNDER BOTH SOBER AND INTOXICATED CONDITIONS. RESULTS SHOW THAT INGESTION OF ALCOHOL AND TIME-ON-TASK PRODUCE SIGNIFICANT EFFECTS ON EYEBLINK FREQUENCY, EYE CLOSURE DURATION, AND RATIO OF LONG DURATION EYEBLINKS TO "REGULAR" BLINKS. NONE OF THESE EFFECTS WAS ASSOCIATED WITH SUBJECTS GOING TO SLEEP SINCE THE ANALYSES EXCLUDED ALL EYE CLOSURE DURATIONS IN EXCESS OF 150 MILLISECONDS. FREQUENCY OF BLINKS ACROSS FILMS INCREASED WHEN THE SUBJECTS WERE SOBER AND REMAINED CONSTANT WHEN SUBJECTS WERE INTOXICATED. NOT ONLY IS BLINK CLOSURE DURATION AFFECTED BY ALCOHOL, BUT A TIME-ON-TASK EFFECT IS ALSO READILY APPARENT SINCE, UNDER BOTH SOBER AND DRUNK CONDITIONS, SUBJECTS GENERATED SIGNIFICANTLY LONGER DURATION BLINK CLOSURES TO THE SECOND FILM AS COMPARED TO THE FIRST FILM. THE INCIDENCE OF INCREASED

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NUMBER OF LONG DURATION BLINKS WHILE INTOXICATED IMPLIES THAT THE INTOXICATED DRIVER OFTEN DOES NOT ADEQUATELY PROCESS VISUAL INFORMATION.

by LARRY R. BEIDEMAN; JOHN A. STERN  
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1977; 9REFS  
SUPPORTED, IN PART, BY PHS RES. GRANT 20995.  
Availability: SEE PUBLICATION

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### **DOT'S THINK TANK PONDER'S "AUTOS BEYOND '85"**

INNOVATIVE, COMPLICATED, TECHNOLOGICALLY ADVANCED, AND EXPENSIVE VEHICLES WILL BE NEEDED IN ORDER TO MEET THE GOVERNMENT'S FUEL ECONOMY AND OTHER REGULATIONS AFTER 1985, ACCORDING TO THE TRANSPORTATION SYSTEMS CENTER (TSC) IN CAMBRIDGE, MASS. NEW AND EXPENSIVE MATERIALS WILL BE REQUIRED TO MAKE SIGNIFICANT IMPROVEMENTS IN FUEL ECONOMY, FOR EXAMPLE BORON AND GRAPHITE IMPREGNATED FIBERS IN EPOXY RESINS WHICH HAVE STRENGTH EQUAL TO OR GREATER THAN STEEL. COMPLETE ELECTRONIC CONTROL OF ALL THE ELEMENTS OF VEHICLES WILL BE NECESSARY TO OPTIMIZE VEHICLE PERFORMANCE. SETTING MILEAGE STANDARDS FOR LIGHT TRUCKS AND VANS IS DIFFICULT BECAUSE OF THEIR WIDE VARIETY OF CONFIGURATIONS. MICROPROCESSORS ARE BEING USED ON AN EXPERIMENTAL BASIS TO GATHER DATA AND EVALUATE VARIOUS ADD-ON DEVICES WHICH WOULD IMPROVE FUEL ECONOMY FOR HEAVY-DUTY TRUCKS. MAINTENANCE SCHEDULES ARE BEING EVALUATED FOR THEIR IMPACT ON FUEL ECONOMY. DATA AND ANALYSIS ARE BEING DEVELOPED FOR THE DEPT. OF TRANSPORTATION FOR USE WHEN REQUESTS FOR WAIVERS ARE SUBMITTED BY VEHICLE MANUFACTURERS. OTHER DEVICES UNDER DEVELOPMENT INCLUDE A TRANSPORTABLE BREATH ANALYZER, AND A METER-TYPE DEVICE THAT WOULD HELP DRIVERS IMPROVE THE FUEL ECONOMY OF CARS NOW ON THE ROAD. TO HELP THE URBAN MASS TRANSIT ADMINISTRATION A MATERIALS DATA BANK HAS BEEN SET UP TO KEEP TRACK OF MATERIALS BEING CONSIDERED FOR MASS TRANSIT VEHICLES THAT ARE TOXIC OR FLAMMABLE. TSC HAS ALSO BEEN ACTIVE IN ENVIRONMENTAL AREAS, INCLUDING NOISE ABATEMENT, DIESEL PARTICULATES, STUDIES TO EVALUATE THE POLLUTION IMPACT OF VARIOUS TRANSPORTATION PROJECTS, AND THE DEVELOPMENT OF POLLUTION MEASURING INSTRUMENTS.

by JOSEPH M. CALLAHAN  
Publ: AUTOMOTIVE INDUSTRIES V158 N4 P46-50 (MAR 1978)  
1978  
Availability: SEE PUBLICATION

HS-022 783

### **RESEARCH ON THE CORRELATION BETWEEN STATIC AND DYNAMIC EXPERIMENTS CONDUCTED ON MOTORBUS [BUS] SAFETY SUPPORTS (ISPITIVANJE KORELACIJE IZMEDJU STATICKIH I DINAMICKIH EKSPERIMENTATA SPROVEDENIH ISPITIVANJEM SIGURNOSNE KONSTRUKCIJE AUTOBUSA; ISSLEDOVANIYE KORRELYATSH MEZHDU STATICHESKIMI I DINAMICHESKIMI EKSPERIMENTAMI, PROVEDENNYM BEZOPASNOY UPORNOY KONSTRUKTSIYEY AVTOBUSOV)**

STATIC AND DYNAMIC EXPERIMENTS HAVE BEEN CONDUCTED ON THE RECTANGULAR TUBING WHICH COMPOSES THE FRAMES OF MOTORBUSES; AND EXPERIMENTAL ENERGY-ABSORBING MOTORBUS SAFETY BUMPER DESIGNS HAVE BEEN FORMULATED. THE NEED FOR AN INCREASE IN THE PASSIVE SAFETY OF MOTORBUSES WITH REGARD TO HEAD-ON COLLISIONS IS EVIDENCED BY THE HIGH COST OF BUS REPAIR AFTER LOW-SPEED COLLISIONS. ON THE BASIS OF EXPERIMENTS CONDUCTED ON RECTANGULAR TUBES, LABORATORY EXPERIMENTS WERE CONDUCTED ON ENERGY-ABSORBING DESIGNS OF BUMPERS WHICH ABSORB ENERGY BY PLASTIC DEFORMATION. THE SAFETY BUMPER IS MOUNTED TO THE SIDE ELEMENTS OF THE BUS FRAME, AND THE ATTACHMENT PROVIDES FOR FAST AND SIMPLE REPLACEMENT OF THE BUMPER IF IT IS DEFORMED AND DAMAGED. THE BUMPER IS RIGID, THEREBY TRANSMITTING THE LOAD TO THE ENERGY-ABSORBING SYSTEM IN A HEAD-ON COLLISION. THE COVERING REDUCES THE DANGER OF INJURY TO PEDESTRIANS AND CYCLISTS AND PROTECTS THE BUS FROM DAMAGE IN COLLISIONS WITH LIGHT VEHICLES. THE RECTANGULAR TUBING USED IN EXPERIMENTS ABSORBS MOST OF THE SHOCK LOAD ENERGY. THERE IS A CORRELATION BETWEEN STATIC AND DYNAMIC EXPERIMENTS IF: IMPOSITION OF THE LOAD; INSPECTION OF THE LOAD AT PLACE OF IMPOSITION; AND LIMITING CONDITIONS ARE IDENTICAL DURING STATIC AND DYNAMIC EXPERIMENTS. DURING THE EXPERIMENTS "COLLISION FORCE-TIME" AND "DISPLACEMENT-TIME" DIAGRAMS WERE COMPILED. THE FORCE MEASUREMENTS WERE REDUCED TO THE MEASUREMENTS OF DEFORMATION OF CYLINDRICAL BODIES UPON AXIAL COMPRESSION AND THE DISPLACEMENT MEASUREMENTS WERE REDUCED TO THE MEASUREMENT OF THE DEFORMATION OF A THIN STEEL PLATE UNDER A BENDING LOAD. THE MAXIMUM DEFORMATION WAS DETERMINED ACCORDING TO THE SO-CALLED "BASIC CURVE" WHICH MAY BE OBTAINED BY "REJECTING" THE INHERENT FREQUENCIES OF THE DISPLACEMENT SENSOR ROD FROM THE CURVE. EXPERIMENTS SHOWED THAT POLYURETHANE FOAM INCREASES THE RIGIDITY AND WEIGHT OF THE AS-

SEMBLY ONLY SLIGHTLY BUT HAS A SIGNIFICANT EFFECT ON ENERGY ABSORPTION.

by CHABA MOLNAR  
SCIENTIFIC RES. INST. OF THE AUTOMOBILE  
INDUSTRY, BUDAPEST 1502, P.O. BOX 25, HUNGARY  
1977?; 33P 4REFS  
TEXT ALSO IN HUNGARIAN AND RUSSIAN.  
Availability: TECHTRAN CORP., P.O. BOX 729, GLEN  
BURNIE, MD.

**DESIGN PROBLEMS IN THE SAFETY SHOCK  
SYSTEMS OF BUSES (AUTOBUSZOK BIZTONSAGI  
UTKOZOSZER-KEZETENEK TERVEZESI  
PROBLEMAI)**

IN JOINT RESEARCH AND DEVELOPMENT OF THE "SAFETY AUTOBUS," EFFORTS WERE MADE TO REDUCE HEAD-ON COLLISION DAMAGE TO BUS AND PASSENGERS. THE AMERICAN EXPERIMENTAL SAFETY VEHICLE DECELERATION LIMITING CURVE WAS USED TO ILLUSTRATE THE EFFECTS OF DECELERATION ON DRIVER AND PASSENGERS IN A CRASH. AN ENERGY-ABSORBING STRUCTURE (BUMPER) WAS DEvised WHICH PROJECTS FURTHER THAN USUAL FROM THE FRONT OF THE BUS. MOVING CHARACTERISTICS DURING A COLLISION WERE REPRESENTED BY FOUR MOMENTS. THE ENERGY DENSITY DEPENDENCE OF THE ENERGY-ABSORBING SHOCK SYSTEM WAS REPRESENTED IN SIX TYPICAL PHASES: ELASTIC DEFORMATION, THE BEGINNING OF LOCAL DEFORMATION, FORMATION OF THE FIRST FOLD, SUCCESSIVE FOLDS, THE PLASTIC, SEMIRIGID SEGMENT, AND THE INTRODUCTION OF THE STRUCTURAL "BRIEF CLOSURE" (EXHAUSTION OF CAPACITY FOR DEFORMATION). THE ENERGY DENSITY DEPENDENCE OF THE SHOCK SYSTEM IS ADAPTED TO THE TOTAL FRAME SO THAT THE DEFORMATION DOES NOT REACH THE FRONT SECTION OF THE CHASSIS SUSPENSION, NOR THE DRIVER'S SAFETY PANEL AND STEERING COLUMN. ENERGY RELATIONS ARE DESCRIBED IN A TYPICAL VEHICULAR CRASH.

by M. MATOLCSY; CS. MOLNAR  
1975; 45P 6REFS  
PRESENTED AT 11TH INTERNATIONAL MEETING ON  
VEHICLE TECHNOLOGY, KARL-MARX-STADT, 18-19  
SEP 1975. TEXT ALSO IN HUNGARIAN.  
Availability: TECHTRAN CORP., P.O. BOX 729, GLEN  
BURNIE, MD.

**UPGRADING OF BUS ROOF STRENGTH WITH  
REGARD TO ROLL-OVER ACCIDENTS  
(DACHFESTIGKEITSBEFORDERUNGEN BEI  
OMNIBUSSEN IM BEZUG DER  
UBERSCHLAGUNFALLEN; ZAHTEVI CVRSTOCE  
KROVA AUTOBUSA SA STANOVISTA  
PREVRTANJA)**

A LABORATORY TEST METHOD IS DESCRIBED TO EVALUATE BUS ROOF STRENGTH IN ROLLOVER ACCIDENTS UNDER DIFFERENT CIRCUMSTANCES. THE

LABORATORY TEST HAS THE ADVANTAGE OF LOW COST, SINCE IT MAY BE CONDUCTED ON THE FRAME OF A VEHICLE. THE TEST WAS DESIGNED TO SIMULATE ROLLING OFF A HIGHWAY WITH REGARD TO SPEED, SINCE THIS TYPE OF ROLLOVER ACCIDENT IS MOST FREQUENT. IN THE INITIAL PHASES OF THE CRASH TEST, THERE ARE TWO IMPACT PHASES WHICH CAUSE PERMANENT DEFORMATION OF ROOF STRUCTURE. THIS REPLACEMENT OF ROOF STRUCTURE MUST BE LIMITED FOR BETTER PASSENGER PROTECTION. THE LOAD CAPACITY OF ROOF STRUCTURE (THE REQUIRED ENERGY ABSORPTION) MAY BE DETERMINED BY MATHEMATICAL FORMULA, ACCORDING TO VEHICLE CATEGORY, SUCH AS CITY AND SUBURBAN BUSES, AND COUNTRY AND TOURING BUSES OF VARYING HEIGHTS.

by ANDRAS VOITH  
AUTOMOTIVE RES. INST., AUTOKUT, BUDAPEST, HUNGARY  
1977; 27P 7REFS  
TEXT ALSO IN GERMAN AND HUNGARIAN.  
Availability: TECHTRAN CORP., P.O. BOX 729, GLEN  
BURNIE, MD.

**EYE MOVEMENTS IN CURVE NEGOTIATION**

EYE MOVEMENTS AND FIXATIONS OF FIVE DRIVERS WERE RECORDED AND SUPERIMPOSED VIDEOTAPED RECORDING OF THE DYNAMIC VEHICLE SCENE AS THE DRIVERS PROCEEDED ON A TWO-LANE RURAL ROAD. IT WAS DEMONSTRATED THAT DRIVERS RELY ON DIFFERENT VISUAL CUES FOR DIRECTIONAL AND LATERAL CONTROL ON CURVED ROADS FROM THOSE THEY USE FOR STRAIGHT ROADS. DRIVERS START SCANNING CURVES EARLY AND USE DIRECTIONAL CUES AS THEY APPROACH THE CURVE. THEY RESORT TO DIRECT FOVEAL FIXATIONS OF THE ROADWAY CLOSE TO THE CAR FOR LATERAL PLACEMENT CUES. ON STRAIGHT ROADS, THE SCANNING BEHAVIOR IS LESS ACTIVE AND MOST OF THE FIXATIONS ARE CLOSE TO THE FOCUS OF EXPANSION. IT IS RECOMMENDED THAT ON CURVED ROAD APPROACH ZONES OR SIGHT DISTANCE BE INCREASED TO PROVIDE MORE TIME FOR THE DRIVER TO ASSESS THE CURVE PRIOR TO ENTRY. THIS IS ESPECIALLY NECESSARY ON ROADS DESIGNED FOR HIGH SPEED. THE OPTIMUM PLACEMENT OF ADVISORY CURVE SIGNS MAY BE JUST PRIOR TO THE BEGINNING OF THE APPROACH ZONE. IF THE PRELIMINARY FINDINGS PRESENTED ARE SUPPORTED BY FUTURE RESEARCH, EYE MOVEMENTS MAY BE A USEFUL TOOL FOR THE IDENTIFICATION OF ESPECIALLY DANGEROUS CURVES AND THE RECOMMENDATION OF SAFETY-RELATED CURVE MODIFICATIONS.

by DAVID SHINAR; EDWARD D. MCDOWELL; THOMAS H. ROCKWELL  
Publ: HUMAN FACTORS V19 N1 P63-71 (1977)  
1977; 15REFS  
FUNDED BY FEDERAL HWY. ADMINISTRATION  
OHIO DEPT. OF TRANSPORTATION TO PROJ. EEO-1  
OHIO STATE UNIV.  
Availability: SEE PUBLICATION

September 30, 1978

HS-022 787

#### **TYPICAL VEHICLE DIURNAL. IN-HOUSE TEST PROGRAM REPORT NO. 4**

THE PRESENT KNOWLEDGE IS REVIEWED CONCERNING THREE ASPECTS OF FUEL TANK DIURNAL BREATHING LOSSES (FUEL EVAPORATIVE EMISSIONS DUE TO DAILY CHANGES IN FUEL SYSTEM TEMPERATURE): TYPICAL DAILY TEMPERATURE RANGES, TYPE AND AMOUNT OF FUEL IN THE FUEL TANK AND ITS EFFECT ON DIURNAL EMISSIONS, AND LENGTH OF A TYPICAL DIURNAL. THESE ASPECTS ARE COMPARED TO CURRENT TEST PROCEDURE. AN INSTRUMENTED TANK PROVIDED DATA FOR EVALUATION OF IMPORTANT DIFFERENCES BETWEEN A REAL LIFE DIURNAL AND A SIMULATED TEST PROCEDURE, WITH SPECIAL EMPHASIS ON THE EVOLUTION OF HYDROCARBON VAPORS. A REVIEW OF THE LITERATURE INDICATED THAT THE TYPICAL DAILY TEMPERATURE RANGE IS 64°-84° F RATHER THAN 60°-84° F, THAT THE DIURNAL OCCURS OVER A TEN-HOUR PERIOD (TESTING IS FOR ONE HOUR), AND THAT THE NORMAL FUEL TANK IS FILLED TO 59% OF CAPACITY RATHER THAN 40%, AS IN CURRENT TEST SIMULATIONS.

by GARY M. WILSON; THOMAS RARICK  
ENVIRONMENTAL PROTECTION AGENCY,  
STANDARDS DEVEL. AND SUPPORT BRANCH, ANN  
ARBOR, MICH. 48105  
Rept. No. PB-270 690; EVAP-76-3; 1976; 62P 11REFS  
Availability: NTIS

HS-022 788

#### **A HIGH-SPEED ROAD PROFILOMETER - PRELIMINARY DESCRIPTION**

A PROTOTYPE ROAD PROFILOMETER FOR MEASURING IRREGULARITIES OF THE ROAD SURFACE IS DESCRIBED WHICH EMPLOYS OPTICAL DISPLACEMENT TRANSDUCERS INCORPORATING A SEMICONDUCTOR LASER. WHEN TOWED BEHIND AN ESTATE-CAR (STATION WAGON) IT IS CAPABLE OF OPERATION AT SPEEDS UP TO 80 KM/H AND MEASURES LONGITUDINAL PROFILE FEATURES FROM 0.2 M TO 100 M OR MORE IN LENGTH WITH A RESOLUTION OF BETTER THAN 1 MM AND WITH AN ERROR IN THE CURVATURE OF THE PROFILE OF NOT MORE THAN 0.3 KM TO THE -1 POWER IN DISTANCES OF 100 M. RECORDS OF THE MEASURED PROFILE ARE MADE BY COMPUTER ON MAGNETIC TAPE AND IF REQUIRED IN THE FORM OF A GRAPH.

by R. S. DICKERSON; D. G. W. MACE  
DEPARTMENT OF THE ENVIRONMENT, TRANSPORT  
AND ROAD RES. LAB., CROWTHORNE, BERKS.,  
ENGLAND  
Rept. No. TRRL-SR-182; PB-276 126; 1976; 17P 3REFS  
Availability: CORPORATE AUTHOR

HS-022 790

HS-022 789

#### **AN INVESTIGATION OF DRAG REDUCTION ON BOX-SHAPED GROUND VEHICLES. SEMI-ANNUAL STATUS REPORT**

DRAG COEFFICIENTS WERE PLOTTED AGAINST REYNOLDS NUMBERS BASED ON AN EFFECTIVE DIAMETER FOR EACH CONFIGURATION AT WIND ANGLES OF 0°, 5°, 10°, 20°, AND 30°. CONFIGURATIONS 1 AND 5 WERE USED AS REFERENCE CONFIGURATIONS. COMPARISON GRAPHS SHOWED THAT THE ROUGH BOTTOM INCREASED DRAG ABOUT 10% OVER A SMOOTH BOTTOM, ROUNDED FRONT END REDUCED DRAG 58%, AND THE STREAMLINED REAR END REDUCED DRAG 20%. THE BEST CONFIGURATION WOULD APPEAR TO BE THE ONE NUMBERED 15, WITH SQUARE LONGITUDINAL CORNERS. THE RESULTS ARE TABULATED OF A COMPARISON BETWEEN COMPARABLE DATA POINTS MADE AT NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA) FLIGHT RES. CENTER AND THE WIND TUNNEL MODELS. METHODS ARE PRESENTED OF COMPUTING THE POWER REQUIRED TO OVERCOME AERODYNAMIC DRAG AT 55 MPH FOR EACH CONFIGURATION AND THE BASE DATA PROVIDED.

by VINCENT U. MUIRHEAD  
UNIVERSITY OF KANSAS, CENTER FOR RES., INC.,  
LAWRENCE, KANS.  
NSG-4004  
Rept. No. N76-70872; NASA-CR-146028; 1976; 36P  
REPT. FOR 31 JUL 1975-15 JAN 1976.  
Availability: NTIS

HS-022 790

#### **DETERMINATION OF THE EFFECTIVENESS AND FEASIBILITY OF REGENERATIVE BRAKING SYSTEMS ON ELECTRIC AND OTHER AUTOMOBILES. VOL. 1. SUMMARY**

REGENERATIVE BRAKING CONCEPTS APPLICABLE TO AUTOMOBILES USING ELECTRIC, HYBRID, OR HEAT ENGINE-POWER SYSTEMS WERE EVALUATED FOR PERFORMANCE IMPROVEMENT, ENERGY SAVING, AND COST-EFFECTIVENESS. FOR PRIVATELY OWNED AUTOMOBILES DRIVEN 10,000 MILES/YEAR (16,100 KM) IN AN URBAN ENVIRONMENT, REGENERATIVE BRAKING WAS FOUND COST-EFFECTIVE. IT IS RECOMMENDED FOR USE ON ELECTRIC-POWERED AND HYBRID-POWERED AUTOMOBILES, SINCE THESE ALREADY HAVE THE BASIC COMPONENTS NEEDED FOR REGENERATIVE BRAKING. THE ADDITION OF THIS SYSTEM TO THE STANDARD HEAT ENGINE-POWERED AUTOMOBILE WAS FOUND NOT COST-EFFECTIVE, EXCEPT FOR COMMERCIAL VEHICLES SUCH AS TAXIS, CITY BUSES, OR DELIVERY VANS THAT SEE HIGH ANNUAL USAGE UNDER STOP-AND-GO CONDITIONS. REGENERATIVE BRAKING WILL NOT REPLACE THE VEHICLE'S NORMAL SERVICE BRAKES FOR "HARD" BRAKING, BUT

WILL SAVE A SIGNIFICANT AMOUNT OF ENERGY IN MODERATE DECELERATION.

by D. D. DAVIS; R. A. RENNER; F. C. YOUNGER; R. C. EPPS; S. S. LERNER  
UNIVERSITY OF CALIFORNIA/LIVERMORE,  
LAWRENCE LIVERMORE LAB., LIVERMORE, CALIF.  
94550  
W-7405-ENG-48  
Rept. No. UCRL-52306-VOL-1; 1977; 77P 36REFS  
Availability: NTIS

HS-022 791

### PEDESTRIAN AND CYCLE SEGREGATION [UNITED KINGDOM]

THE EVOLUTION OF SEGREGATED PEDESTRIAN AND CYCLE ROAD SYSTEMS OVER THIRTY YEARS IS DESCRIBED. SEGREGATION IS VIEWED AS THE MOST OBVIOUS METHOD FOR PROTECTING VULNERABLE PEDESTRIANS AND CYCLISTS. PEDESTRIAN SEGREGATION IS CONSIDERED NORMAL, BUT BICYCLE SEGREGATION IS STILL IN ITS INFANCY. AN ADEQUATE SEGREGATED CYCLEWAY SYSTEM IS CONSIDERED IMPORTANT FOR ENCOURAGING MORE CYCLING AS AN ENERGY SAVING MEASURE. JOINT USE OF LOW-TRAFFIC ROADS BY CYCLES AND AUTOMOBILES IS DISCUSSED, AS IS JOINT USE OF PATHS BY CYCLISTS AND PEDESTRIANS. THE USE OF UNDERPASSES AND BRIDGES TO CARRY PEDESTRIANS AND CYCLISTS BENEATH OR OVER HIGHWAYS IS ALSO DISCUSSED. SEGREGATED ROUTES ARE FOUND TO BE NECESSARY IN RESIDENTIAL, INDUSTRIAL, AND TOWN CENTER AREAS, AS WELL AS IN RURAL AREAS WITHIN TOWN BOUNDARIES. THE NEED IS EMPHASIZED FOR COORDINATING TOWN PLANNING TO PROVIDE SEGREGATED PEDESTRIAN AND BICYCLE ROADWAYS. THE RESULT IS A MORE CIVILIZED ENVIRONMENT, FREE FROM THE NOISE, FUMES, AND DANGER OF MOTOR VEHICLES. STATISTICS ARE PROVIDED IN COMPARING ACCIDENT FREQUENCY AT A SEGREGATED AND A NONSEGREGATED LOCATION.

by K. C. STANLEY  
Publ: TECHNICAL ASPECTS OF ROAD SAFETY V67 N6  
P2.1-2.10 (1977)  
1977; 10P  
Availability: SEE PUBLICATION

HS-022 792

### HEAD INJURY AND HEAD PROTECTION IN TRAFFIC SAFETY

THE IMPORTANCE OF HEAD PROTECTION IN TRAFFIC SAFETY FOR MOTORCYCLISTS IS DEMONSTRATED, AND THE CONCEPT OF HEAD PROTECTION AS A BARRIER TO THE TRANSFER OF IMPACT ENERGY IS PROPOSED. THERE IS A NEED FOR INCREASED KNOWLEDGE OF HUMAN TOLERANCE TO HEAD IMPACT, WITH A SURVEY OF SOME PROMISING METHODS FOR ATTAINING SUCH KNOWLEDGE. AN INCREASE IN THE USE OF MOTORCYCLES, ESPECIALLY BY YOUNG PEOPLE, IN THE U.S. SPARKED THE DEVELOPMENT OF RESEARCH IN HEAD PROTECTION FOR MOTORCYCLISTS. STUDIES INCLUD-

ING THOSE IN AUSTRALIA (1964) AND BY THE FEDERAL GOVERNMENT (1966 AND 1974) SHOW THAT THE RISK OF FATALITY WAS REDUCED ONE THIRD BY THE USE OF HELMETS, AND TWO THIRDS OF MOTORCYCLE FATALITIES DUE TO HEAD INJURIES. WHEN HELMETS WERE USED, FATAL OR SERIOUS INJURIES WERE TIMES GREATER AND HEAD INJURY OF ALL WAS TWICE AS GREAT. HELMETS WERE FOUND TO BE EQUALLY EFFECTIVE AT SPEED RANGES 30 TO OVER 50 MPH. ANOTHER STUDY SHOWED A SUCCESSION OF IMPACTS OF LESSER INTENSITY CAUSES SIGNIFICANT BRAIN DAMAGE PRODUCES SIGNIFICANT PATHOLOGY. SKULL FRACTURE, WITH OR WITHOUT BRAIN DAMAGE CLOSED HEAD INJURY (CONCUSSION) IS DISCUSSED. THE DEGREE OF UNDERLYING DAMAGE IS A FUNCTION OF IMPACT KINETIC ENERGY TRANSFERRED TO THE BRAIN, AND THE TYPE OF INJURY MAY BE RELATED TO THE CHARACTER OF CONFIGURATION, AND POTENTIAL DEFORMATION OF THE IMPACTING OR IMPACTED OBJECT. THE LACK OF DEFINITIVE AND COMPLETE INFORMATION ON HUMAN TOLERANCE TO HEAD IMPACT IS ONE OF THE MOST SIGNIFICANT OBSTACLES TO THE ESTABLISHMENT OF HEAD PROTECTION CRITERIA. AN IMPACT STUDY TECHNIQUE UTILIZING HUMAN CADAVERS SHOWS PROMISE IN ESTABLISHING PROPER HUMAN TOLERANCE LEVELS. ANOTHER APPROACH IS BASED ON FIELD ACCIDENT DATA AND LABORATORY SIMULATION UNDER CONTROLLED CONDITIONS. THE NEED FOR STANDARDIZED TESTING OF HEAD PROTECTIVE DEVICES PRODUCED PROGRESSIVELY MORE EFFECTIVE AND SOPHISTICATED TEST TECHNIQUES, SUCH AS "SURVIVABLE PEAK ACCELERATION LEVELS" DERIVED BY USING A HELMETED TEST HEAD. A DUMMY TEST HEAD HAS BEEN DEVELOPED WHICH RESEMBLES VERY CLOSELY THE RESPONSE OF HUMAN CADAVER HEADS IN IMPACT RESPONSES.

by GEORGE G. SNIVELY; SUZANNE A. SNIVELY  
PHS-EC-00013  
Publ: TECHNICAL ASPECTS OF ROAD SAFETY V67 N6  
P3.F-3.F.6 (1977)  
1977; 7P 15REFS  
Availability: SEE PUBLICATION

HS-022 793

### DRUGS AND DRIVING - WHERE DO WE GO FROM HERE? [UNITED KINGDOM]

FIGURES ON DRUG USE BY DRIVERS ARE MISLEADING, SINCE DRIVERS ARE SELDOM TESTED FOR BLOOD CONCENTRATION OF DRUGS. DRUG USE IS MUCH MORE PREVALENT THAN PRESENT FIGURES INDICATE. IN ONE STUDY, IT WAS DISCOVERED THAT THE ADDITION OF ALCOHOL TO PHENYLETHYLBITONE, SECOBARBITONE, OR METHAQUALONE SHARPLY INCREASED THE PERCENTAGE OF FATALITIES, BUT NO CORRELATION COULD BE ESTABLISHED BETWEEN BLOOD LEVEL CONCENTRATION AND THE EFFECT ON THE DRIVER. THE EFFECT OF DRUGS ON DRIVING HAS BEEN STUDIED BY MEASURING DRIVING PERFORMANCE WITH VARIOUS DOSAGES UNDER CONTROLLED CONDITIONS, BY

MEASUREMENT CAN BE MADE OF THE EFFECT OF CHRONIC DRUG USE NOR OF THE EFFECT OF DRUG COMBINATIONS WITH ALCOHOL. BLOOD ANALYSIS FOR DRUGS IS INFINITELY MORE DIFFICULT THAN BLOOD ALCOHOL ANALYSIS. THE STUDY OF DRUG INVOLVEMENT AND ACCIDENTS IS THE ONLY USABLE RESULT OF BLOOD DRUG ANALYSIS. ANALYSIS OF URINE SAMPLES FOR DRUGS CAN BE ACCOMPLISHED MUCH MORE READILY THAN BLOOD ANALYSIS, ALTHOUGH THE QUANTITATIVE RESULTS DO NOT NECESSARILY RELATE TO A DRUG'S EFFECT. THE GENERAL METHOD FOR URINALYSIS FOR DRUGS IS OUTLINED. THE LEGISLATIVE CONTROL OF DRUG CONCENTRATION IN DRIVERS IS NOT CONSIDERED FEASIBLE, NOR IS A MANDATORY BAN ON CERTAIN DRUGS, SINCE THEIR THERAPEUTIC VALUE MAY OUTWEIGH THEIR DETRIMENTAL EFFECTS.

by A. S. CURRY

Publ: TECHNICAL ASPECTS OF ROAD SAFETY V67 N6  
P3.G-3.G.4 (1977)

1977; 5P

Availability: SEE PUBLICATION

HS-022 794

#### **INFLUENCE OF DIFFERENT TYPES OF SHOCK ABSORBERS ON THE BRAKING PROPERTIES OF A VEHICLE**

THE INFLUENCE ON A VEHICLE'S BRAKING CHARACTERISTICS OF A CHANGE IN SUSPENSION WAS INVESTIGATED. THIS CHANGE WAS BROUGHT ABOUT BY EQUIPPING THE REAR SHOCK ABSORBERS WITH A PROGRESSIVE SPRING, OR BY PROVIDING MEMBRANES IN PARALLEL WITH SHOCK ABSORBERS AND THE SPRING. PARTICULAR ATTENTION WAS GIVEN TO VEHICLES EQUIPPED WITH A BRAKE FORCE DISTRIBUTION VALVE. THREE TYPES OF SHOCK ABSORBERS WERE USED: MONRO-MATIC (MM), LOAD-LEVELER (LL) STABILIZING UNIT (HEAVY DUTY, WITH PROGRESSIVE RATE COIL SPRING), AND RIDE LEVELER (RL) (COMBINATION OF AIR ADJUSTABLE ROLLING MEMBRANE WITH DEPENDABLE SHOCK ABSORBER). IT WAS FOUND THAT THE DECELERATION OF A VEHICLE BRAKING ON ALL FOUR WHEELS DOES NOT DEPEND ON THE TYPE OF SHOCK ABSORBER INSTALLED IN THE VEHICLE, BUT THAT WHEN AN RL IS USED IN A LOADED CAR, A LARGER PEDAL FORCE IS NEEDED FOR THE SAME DECELERATION. WITH A SERVO BOOSTER IN THE BRAKE SYSTEM, THE PEDAL FORCE NECESSARY TO OBTAIN A DECELERATION OF 5.8 METERS PER SECOND PER SECOND WILL NOT EXCEED 50 DAN. IT IS ADVISABLE TO READJUST THE LOAD-SENSITIVE REGULATORS WHEN USING THE RL SHOCK ABSORBER. WHEN BRAKE FORCE REGULATORS ARE USED, THE SPEED OF APPLIED BRAKE FORCE HAS A HIGH INFLUENCE ON DECELERATION. AUXILIARY SPRINGS WILL PREVENT THE REAR WHEEL BRAKES LOCKING BEFORE THOSE ON THE FRONT WHEELS.

by R. VERSCHOORE

Publ: TECHNICAL ASPECTS OF ROAD SAFETY V67 N6  
P4.1-4.19 (1977)

1977; 19P

Availability: SEE PUBLICATION

HS-022 795

#### **THE DYNAMIC CHARACTERISTICS OF AUTOMOBILE SEATS WITH HUMAN OCCUPANTS**

THE DYNAMIC CHARACTERISTICS OF SEATED HUMANS WERE MEASURED IN A LABORATORY ENVIRONMENT. THE SEAT/OCCUPANT SYSTEM WAS EXCITED VERTICALLY WITH RANDOM VIBRATION. RELEVANT TRANSFER FUNCTIONS WERE COMPUTED USING REAL TIME ACCELERATION SIGNALS FED TO A FOURIER ANALYZER. THE TRANSFER FUNCTIONS DESCRIBE THE SEAT RESPONSE, THE HUMAN RESPONSE, AND THE COMBINED RESPONSE IN THE FREQUENCY RANGE FROM 2 TO 20 HERTZ (HZ). OF POSSIBLE SIGNIFICANCE IN RIDE QUALITY STUDIES ARE THE NATURAL MODES OF VIBRATION WHICH WERE IDENTIFIED; THESE INCLUDE A 3.0 HZ "HEAD-NOD" MODE, A 3.9 HZ SEAT VERTICAL MODE, A 5.6 HZ HUMAN RESPONSE MODE, AND A SEAT "BACK-SLAP" MODE OCCURRING AT 11 HZ.

by JOHN H. VARTERASIAN; RICHARD R. THOMPSON  
GENERAL MOTORS CORP., RES. LABS.

Rept. No. SAE-770249; 1977; 12P 14REFS

PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION, DETROIT, 28 FEB-4 MAR 1977.

Availability: SAE

HS-022 796

#### **DEVELOPMENT AND EVALUATION OF A SEMI-RECLINING DRIVER'S SEAT FOR THE XMI TANK**

AN INITIAL SEAT FIELD TEST WAS PERFORMED WITH FOUR ARMY AND NINE CHRYSLER TANK DRIVERS TO TEST A SEMIRECLINING DRIVER'S SEAT FOR AN ADVANCED TANK WHICH WOULD PERMIT A LOW TANK SILHOUETTE WITHOUT ACCELERATING DRIVER FATIGUE. THE TEST DATA INDICATED THAT THE SEAT CONFIGURATION PROVIDED A SATISFACTORY COMPROMISE BETWEEN SILHOUETTE AND DRIVER COMFORT. A SUPPLEMENTARY LABORATORY EXPERIMENT INDICATED IMPROVEMENT IN COMFORT-DISCOMFORT RATINGS AND FAVORABLE REACTIONS TO THE OVERALL DRIVER'S STATION AS A FUNCTION OF INCREASED LEGROOM. RIGOROUS OPERATIONAL EVALUATIONS USING EXPERIENCED ARMY ARMOR PERSONNEL REAFFIRMED THE VALIDITY OF THE SEAT CONCEPT. THE SEAT IS DESCRIBED IN DETAIL AND A COPY OF THE DRIVER EVALUATION FORM IS PROVIDED.

by CURRELL L. PATTIE; RICHARD L. GRAY  
CHRYSLER DEFENSE DIV.

Rept. No. SAE-770250; 1977; 14P 2REFS

PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION, DETROIT, 28 FEB-4 MAR 1977.

Availability: SAE



HS-022 797

### COMFORT EVALUATION OF PASSENGER CARS - THE DEVELOPMENT OF A SIMPLIFIED TEST PROCEDURE

THREE GROUPS OF SIX PASSENGER CARS WERE TESTED BY SUBJECTIVE (JUDGMENT) AND OBJECTIVE (MEASUREMENT) METHODS ON ASPECTS RELATED TO PERSONAL COMFORT AND EASE OF OPERATION. AT ISSUE WAS WHETHER AN EXISTING QUESTIONNAIRE (HUMAN FACTOR QUESTIONNAIRES, BRITISH) COULD BE REPLACED BY A SIMPLER ONE (OVER ALL RATING, THE NETHERLANDS) WITHOUT LOSS OF RELEVANT INFORMATION. ALSO AT ISSUE WAS WHETHER THE TEST PROCEDURE COULD BE SHORTENED. THE RESULTS FAVORED A MUCH SIMPLIFIED, MORE ECONOMICAL TEST PROCEDURE. A COMPARISON WAS MADE BETWEEN SUBJECTIVE AND OBJECTIVE METHODS IN TESTING VIBRATION AND DRIVER'S FIELD OF VIEW. THERE WAS LACK OF POSITIVE CORRELATION BETWEEN SUBJECTIVE OPINION AND OBJECTIVE MEASUREMENTS OF VIBRATION. OBJECTIVE MEASUREMENTS OF VISIBILITY WERE CONSIDERED SUPERIOR TO SUBJECTIVE OPINION, DUE TO THE POSSIBILITY OF THE "HALO EFFECT" (INFLUENCE OF IRRELEVANT FACTORS).

by J. MORAAL; A. J. VAN EIG; J. B. J. RIEMERSMA  
INSTITUTE FOR PERCEPTION TNO (NETHERLANDS)  
Rept. No. SAE-770251; 1977; 16P 8REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 798

### THE USE OF A MODIFIED S.A.E. [SOCIETY OF AUTOMOTIVE ENGINEERS] H-POINT MACHINE IN ASSEMBLY PLANTS

A SIMPLIFIED IN-PLANT METHOD WAS DEVELOPED TO CHECK SEATING VARIATIONS IN PRODUCTION CARS. THE METHOD PROVIDES INFORMATION FOR DETERMINING THE CAUSES OF ANY IRREGULARITIES. THE EQUIPMENT, WHICH IS TRANSPORTABLE TO ANY SITE, CONSISTS OF A MODIFICATION TO THE S.A.E. H-POINT MACHINE TO REPLACE THE LEG ASSEMBLIES AND T-BAR WITH AN ADJUSTABLE SUPPORT LEG, AND THE ADDITION OF EQUIPMENT TO ESTABLISH A "SURFACE PLATE" INSIDE THE VEHICLE TO BE TESTED. THE EQUIPMENT IS DESCRIBED IN DETAIL AND THE MEASUREMENT PROCEDURE EXPLAINED.

by CHESTER W. KLANN  
FORD MOTOR CO.  
Rept. No. SAE-770252; 1977; 20P 5REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 799

### MEASURING VIBRATION ON SOFT SEATS

TWO EXPERIMENTS WERE CONDUCTED TO A METHOD OF MEASURING THE WHOLE-BODY CAL VIBRATION EXPERIENCED BY PERSONS ON SOFT SEATS. THE METHOD UTILIZES A DUCER MOUNT LOCATED BETWEEN THE SEAT AND THE BODY. IN EXPERIMENT 1, COMFORT CO OBTAINED ON HARD FLAT SEATS ARE SHOW APPLICABLE TO MEASUREMENTS MADE W FIRM BAR OR PLATE PLACED ON A C BENEATH THE ISCHIAL TUBEROSITIES OF A SUBJECT. HOWEVER, SINCE SOME MOUNTS SEAT TRANSMISSIBILITY, A FIRM PLATE (C CONTOURED TO CAUSE SEAT COMPI SIMILAR TO THAT PRODUCED BY THE BU WAS USED IN EXPERIMENT 2 AND IS MENDED FOR SOME APPLICATIONS.

by ELERI M. WHITHAM; MICHAEL J. GRIFFIN  
UNIVERSITY OF SOUTHAMPTON, INST. OF S AND VIBRATION RES., ENGLAND  
Rept. No. SAE-770253; 1977; 12P 11REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 800

### DIESEL CAR EMISSIONS - EMPHASIS ON PARTICULATE AND SULFATE

FIVE DIESEL POWERED, LIGHT-DUTY VEHICLES: PEUGEOT 204D, A MERCEDES 240D, A MERCEDES 300D, A COMPREX-EQUIPPED MERCEDES 220D, PERKINS 6-247 POWERED INTERNATIONAL VESTER PICKUP) WERE USED TO QUANTIFY THE RANGE OF PARTICULATE, SULFATE AS WELL AS OTHER UNREGULATED EMISSIONS OF OXIDIZABLE SMOKE, SULFUR DIOXIDE, ALDEHYDES, SELECTED NONREACTIVE HYDROCARBONS. TRANSIENT DRIVING CYCLES WERE EMPLOYED, INCLUDING THAT USED IN EMISSIONS CERTIFICATION. SULFATE TESTING, AND HIGHWAY FUEL ECONOMY, EMISSION RATES OF PARTICULATE, SULFATE, AND OTHER CONTAMINANTS OF A REGULATED AND UNREGULATED NATURE ARE PRESENTED IN SEVERAL FORMS: MASS PER UNIT OF TIME, PER UNIT OF FUEL CONSUMED, AND PER UNIT OF DISTANCE. FUEL CONSUMPTION AND ECONOMY VALUES ARE ALSO PROVIDED.

by KARL J. SPRINGER; RALPH C. STAHLMAN  
SOUTHWEST RES. INST.; ENVIRONMENTAL  
PROTECTION AGENCY  
EPA-68-03-2116  
Rept. No. SAE-770254; 1977; 32P 17REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE



September 30, 1978

HS-022 804

HS-022 801

## **EPILEPSY AND DRIVING**

OF 205 ACTUAL AND POTENTIAL DRIVERS SUFFERING FROM EPILEPSY WHO WERE EXAMINED OVER A NINE-YEAR PERIOD IN TASMANIA, AUSTRALIA, 26% HAD FAILED TO DISCLOSE THEIR DISABILITY, 16% OF THE TOTAL HAVING HAD AN AUTOMOBILE ACCIDENT. ONLY ABOUT 28% OF THE EXPECTED NUMBER PER YEAR OF NEW CASES OF EPILEPSY HAD DISCLOSED THEIR AFFLICTION. ALCOHOL WAS ASSOCIATED WITH EPILEPSY IN JUST OVER 8% OF THE CASES INVESTIGATED. THE RECOMMENDED REGULATIONS FOR ISSUANCE OF DRIVING LICENSES TO PATIENTS WITH EPILEPSY INCLUDE NO MANIFESTATIONS WHILE AWAKE FOR A TWO-YEAR PERIOD BEFORE ISSUANCE, ANTICONVULSANT MEDICATION TO BE CONTINUED FROM THREE TO FIVE YEARS, REGULAR MEDICAL SUPERVISION OF PATIENTS WHO HAVE HAD AN ATTACK WITHIN THE PREVIOUS FIVE YEARS, AND ABSTENTION FROM ALCOHOL BY APPLICANTS. UNDER THE RECOMMENDED REGULATIONS, ONLY TWO OF 170 DRIVERS HAD A SUBSEQUENT ACCIDENT DUE TO EPILEPSY.

by KEITH SAMUEL MILLINGEN  
Publ: PROCEEDINGS OF THE AUSTRALIAN  
ASSOCIATION OF NEUROLOGISTS V13 P67-72 (1976)  
1976; 6P 12REFS  
Availability: SEE PUBLICATION

HS-022 802

## **PATTERNS OF SAFETY BELT USE AMONG DRIVERS KILLED IN FATAL CRASHES IN VIRGINIA**

SAFETYBELT USAGE OR NONUSAGE WAS NOTED FOR DRIVERS FATALLY INJURED IN MOTOR VEHICLE ACCIDENTS IN VA. DURING FISCAL YEAR 1974. DATA WERE OBTAINED FROM FR300 ACCIDENT REPORT FORMS AND AVAILABLE CORRESPONDING MEDICAL EXAMINER'S REPORTS; ONLY THOSE DRIVERS IN WHOSE VEHICLES SAFETY BELTS HAD BEEN INSTALLED AND WHOSE DEATHS COULD BE DIRECTLY ATTRIBUTED TO THE MOTOR VEHICLE ACCIDENT WERE INCLUDED. OF THE 274 FATALITIES, 34 (12.4%) WERE DESIGNATED AS USERS OF SAFETY BELTS AT THE TIME OF THE ACCIDENT, AND THE REMAINING 240 (87.6%) WERE CLASSIFIED AS NONUSERS. WHEN ACCIDENT-RELATED AND DEMOGRAPHIC VARIABLES WERE EXAMINED, SIGNIFICANT DIFFERENCES BETWEEN USERS AND NONUSERS WERE FOUND FOR SUCH VARIABLES AS DRIVER'S SEX, VEHICLE AGE, TIME OF DAY, DAY OF THE WEEK, ROAD CONDITION, DRIVER ACTIONS, AND WHETHER THE DRIVER HAD BEEN DRINKING. A GREATER PROPORTION OF MALES NOT USING SAFETY BELTS WERE KILLED THAN MALES USING SAFETY BELTS, AND A GREATER PERCENTAGE OF NONUSERS WERE VIOLATING A TRAFFIC LAW AT THE TIME OF THE ACCIDENT; MORE NONUSERS THAN USERS WERE DRINKING AT THE TIME OF THE ACCIDENT. WHEN THE SAFETYBELT USAGE RATE AMONG FATALLY INJURED DRIVERS (12.4%) WAS COMPARED WITH THE USAGE RATE AMONG THE GENERAL DRIVING POPULATION OF VIRGINIA (24.0%)

AND WITH ESTIMATES OF USAGE RATES FOR DRIVERS IN TWO OTHER STATES, STATISTICALLY SIGNIFICANT DIFFERENCES WERE FOUND. WHEN DRIVERS KILLED IN FATAL COLLISIONS WERE COMPARED WITH DRIVERS INVOLVED IN BUT NOT KILLED IN FATAL COLLISIONS, THE SAFETYBELT USAGE RATE WAS FOUND TO BE SIGNIFICANTLY LOWER AMONG THE FATALLY INJURED DRIVERS. IT WAS CONCLUDED THAT SAFETYBELT USERS WERE UNDERREPRESENTED AMONG VIRGINIA FATALITIES, AND THAT SAFETYBELT UTILIZATION WAS ONE OF THE SAFEGUARDS AGAINST FATAL INJURIES AMONG VIRGINIA DRIVERS DURING FISCAL YEAR 1974.

by DEBORAH MITCHELL  
VIRGINIA HWY. AND TRANSPORTATION RES.  
COUNCIL, CHARLOTTESVILLE, VA.  
Rept. No. VHTRC-76-R43; 1976; 13P 16REFS  
SPONSORED JOINTLY BY VA. DEPT. OF HIGHWAYS  
AND TRANSPORTATION AND UNIV. OF VIRGINIA,  
CHARLOTTESVILLE, VA.  
Availability: CORPORATE AUTHOR

HS-022 803

## **MOTORCYCLES AND SAFETY SYMPOSIUM**

NINE ARTICLES, A GENERAL DISCUSSION, AND AN ANNOTATED BIBLIOGRAPHY COVER VARIOUS ASPECTS OF MOTORCYCLE SAFETY. STUDIES ARE REPORTED ON A NUMBER OF FACTORS IN RELATION TO MOTORCYCLE ACCIDENTS, INCLUDING AGE AND EXPERIENCE OF THE DRIVER, MOTORCYCLE VISIBILITY, AND ENGINE CAPACITY. AREAS OF INFORMATION LACK ARE CONSIDERED. AN EVALUATION IS MADE OF THE GRADED MOTORCYCLE LICENSE SCHEME IN WESTERN AUSTRALIA. MOTORCYCLISTS' ATTITUDES TO ROAD SAFETY MEASURES AND APPROACHES TO TRAINING, MOTORCYCLE DESIGN, AND THE PERFORMANCE OF CRASH HELMETS IN N.S.W. ARE DISCUSSED. A COMMENTARY ON THE PAPERS CONCLUDES THE REPORT, WITH A BRIEFLY ANNOTATED BIBLIOGRAPHY. INFORMATION RETRIEVAL CARDS WITH ABSTRACTS AND KEYWORDS ARE PROVIDED FOR INDIVIDUAL FILING SYSTEMS.

AUSTRALIAN ROAD RES. BOARD, MELBOURNE, VIC.,  
AUSTRALIA; COMMONWEALTH DEPT OF  
TRANSPORT, AUSTRALIA  
Rept. No. ARRMS-76/85A; 1976  
PRESENTED AT AUSTRALIAN RD. RES. CENTRE, 18  
JUN 1976.  
Availability: AUSTRALIAN RD. RES. BOARD, P.O. BOX  
156 (BAG 4), NUNAWADING, VIC., AUSTRALIA 3131

HS-022 804

## **AGE, EXPERIENCE AND MOTORCYCLE ENGINE CAPACITY IN MOTORCYCLE ACCIDENTS**

THE HIGH LEVEL OF INVOLVEMENT IN MOTORCYCLE ACCIDENTS OF YOUNG RIDERS, INEXPERIENCED RIDERS, AND MOTORCYCLES WITH HIGH ENGINE CAPACITY IS STUDIED, TAKING INTO ACCOUNT THE DISTANCE RIDDEN IN INTERPRETING THE ROLE OF THESE THREE FACTORS. A STUDY,

BASED ON SOUTH AUSTRALIAN DATA, WAS UNDERTAKEN LATE IN 1973; IT COMPARED A NUMBER OF CHARACTERISTICS OF A SAMPLE OF MOTORCYCLES, AND THEIR USUAL RIDERS, INVOLVED IN ACCIDENTS WITH THOSE OF A SAMPLE NOT INVOLVED IN ACCIDENTS, FOR THE YEAR ENDING 31 MAR 1973. THE ACCIDENT SAMPLE COMPRISED PRIVATELY OWNED MOTORCYCLES INVOLVED IN NONFATAL ACCIDENTS; THEREFORE THE RESULTS OF THE STUDY CANNOT BE GENERALIZED TO THE TOTAL MOTORCYCLE ACCIDENT POPULATION. IN A RE-ANALYSIS OF DATA COLLECTED, HIGH ACCIDENT PROBABILITIES WERE FOUND FOR MOTORCYCLES WITH ENGINE CAPACITIES ABOVE 250 CC, FOR RIDERS AGED 25 YEARS OR LESS, AND FOR RIDERS WITH LESS THAN TWO YEARS RIDING EXPERIENCE. THE HIGHEST ACCIDENT PROBABILITIES WERE FOUND FOR MOTORCYCLES ABOVE 250 CC USUALLY RIDDEN BY YOUNG, INEXPERIENCED RIDERS. THE IMPLICATIONS OF THESE FINDINGS FOR THE LICENSING OF MOTORCYCLISTS ARE DISCUSSED: SINCE ENGINE CAPACITY DOES NOT APPEAR TO AFFECT ACCIDENT PROBABILITY FOR RIDERS AGED OVER 25 YEARS, A LICENSING SCHEME BASED ON RESTRICTING MOTORCYCLES ABOVE 250 CC TO RIDERS AGED OVER 25 IS FELT TO HAVE MORE POTENTIAL FOR ACCIDENT REDUCTION THAN ONE RESTRICTING SUCH MOTORCYCLES TO RIDERS WITH MORE THAN TWO YEARS RIDING EXPERIENCE. IN VIEW OF CERTAIN METHODOLOGICAL DEFICIENCIES IN THE STUDY, IT IS RECOMMENDED THAT FURTHER RESEARCH BE UNDERTAKEN TO VALIDATE (OR REPUDIATE) THE FINDINGS.

by I. R. JOHNSTON; P. W. MILNE; M. H. CAMERON  
COMMONWEALTH DEPT. OF TRANSPORT,  
AUSTRALIA; M. H. CAMERON AND ASSOCIATES,  
AUSTRALIA

Publ: HS-022 803, "MOTORCYCLES AND SAFETY  
SYMPOSIUM," MELBOURNE, 1976 P1-23  
1976; 9REFS

PRESENTED AT THE SYMPOSIUM, AUSTRALIAN RD.  
RES. CENTRE, 18 JUN 1976.  
Availability: IN HS-022 803

HS-022 805

### A STUDY OF MOTORCYCLE CRASHES

HITHERTO UNAVAILABLE DATA WERE GATHERED AND DOCUMENTED ON MOTORCYCLE CRASHES IN N.S.W., AUSTRALIA, TO USE THESE AND OTHER DATA IN CONSIDERING THE ROLES PLAYED BY VARIOUS FACTORS IN MOTORCYCLE CRASHES, TO CONSIDER THE LIKELY OUTCOMES IF SOME OF THE VARIOUSLY PROPOSED COUNTERMEASURES ARE APPLIED; AND TO PROVIDE A BANK OF DATA FOR USE IN FUTURE ANALYSES OF MOTORCYCLE CRASHES. THE RESULTS OF AN INITIAL EXAMINATION OF THE STUDY DATA ARE GIVEN. TRENDS IN MOTORCYCLE CRASH AND RELATED DATA ARE DISCUSSED. SEVERAL HYPOTHESES ARE CONSIDERED IN THE LIGHT OF SOME OF THE CRASH AND SURVEY DATA: THAT MOTORCYCLES WITH "LARGE" ENGINE CAPACITIES ARE OVER-INVOLVED IN CRASHES WHEN RIDDEN BY INEXPERIENCED RIDERS, SO THAT LIMITING INEXPERIENCED RIDERS TO "SMALL" MACHINES WOULD REDUCE CRASH

LOSSES; THAT COMPULSORY USE OF HEADLIGHTS ON MOTORCYCLES WOULD REDUCE THE INCIDENT OF CRASHES; THAT ALCOHOL IS INVOLVED TO LARGE EXTENT IN THESE CRASHES; THAT THE USE OF "OFF-ROAD" TIRES ON SEALED ROADS LEADS TO CRASHES ASSOCIATED WITH SKIDDING; AND THAT COMPULSORY USE OF BRIGHTER, LIGHT-COLOR HELMETS WOULD REDUCE THE INCIDENCE OF CRASHES THROUGH INCREASED MOTORCYCLE CONSPICUITY. THE PRELIMINARY STUDY INDICATES THAT IN PERCENTAGE OF CRASH CASUALTIES, MOTORCYCLES SEEM TO BE ABOUT FOUR TIMES AS DANGEROUS AS THE "AVERAGE" MOTOR VEHICLE. THAT RIDERS WITH LESS THAN ONE YEAR'S RIDING EXPERIENCE WERE INVOLVED IN CRASHES TO A FAR GREATER EXTENT THAN THOSE WITH TWO TO THREE YEARS EXPERIENCE, AND MOTORCYCLES WITH LARGER ENGINE CAPACITIES WERE INVOLVED IN GREATER NUMBERS THAN WOULD BE EXPECTED FROM SURVEY FIGURES. THE NUMBER OF CRASHES WAS REDUCED FOR THOSE RIDERS WITH HEADLAMPS SWITCHED ON DURING THE DAY AND WEARING BRIGHTLY-COLORED RATHER THAN DARK HELMETS, THOUGH A CAUTION IS GIVEN THAT THIS MIGHT BE ATTRIBUTABLE TO THE "SAFETY-CONSCIOUS RIDER" EFFECT.

by R. G. VAUGHAN

ACCIDENT ANALYSIS SECTION, TRAFFIC ACCIDENT RES. UNIT, N.S.W., AUSTRALIA  
Publ: HS-022 803, "MOTORCYCLES AND SAFETY SYMPOSIUM," MELBOURNE, 1976 P24-58  
1976; 20REFS  
PRESENTED AT THE SYMPOSIUM, AUSTRALIAN RD. RES. CENTRE, 18 JUN 1976. SUPPORTED BY COMMONWEALTH GOVERNMENT OF AUSTRALIA.  
Availability: IN HS-022 803

HS-022 806

### THE IMPORTANCE OF MOTORCYCLE VISIBILITY IN ACCIDENT CAUSATION

AN ANALYSIS OF DATA FROM 1508 MOTORCYCLE ACCIDENTS OBTAINED FROM VICTORIAN (AUSTRALIAN) POLICE FILES FOR 1974 INDICATES THAT THE LACK OF VISIBILITY OF THE MOTORCYCLE IS A DOMINANT FACTOR IN A LARGE PROPORTION OF AUTOMOBILE/MOTORCYCLE ACCIDENTS: 16.2% OF ALL MOTORCYCLE ACCIDENTS OCCURRED WHEN ANOTHER ROAD USER MOVED HIS VEHICLE INTO THE PATH OF A MOTORCYCLE WHEN HE/SHE "DID NOT SEE" THE ONCOMING MOTORCYCLE. OF THESE ACCIDENTS, 65% OCCURRED DURING DAYLIGHT, 25% AT NIGHT, AND 8% DURING DAWN OR DUSK. IT IS SUGGESTED THAT PART OF THE PROBLEM MAY BE THE COMPARATIVE RARITY OF MOTORCYCLES AMONG ROAD USERS; AUTOMOBILE DRIVERS BECOME CONDITIONED TO RESPOND TO VISUAL CUES PROVIDED BY THE LARGE VEHICLES THEY ENCOUNTER MORE OFTEN, AND FIND IT DIFFICULT TO NOTICE MOTORCYCLES WHICH ARE SMALLER AND LESS COMMON.

September 30, 1978

HS-022 809

USE OF HEADLAMPS IN THE DAYTIME IS HELPFUL BUT NOT A SOLUTION TO THE PROBLEM.

by M. J. WILLIAMS  
UNIVERSITY OF MELBOURNE, DEPT. OF  
MECHANICAL ENGINEERING, AUSTRALIA  
Publ: HS-022 803, "MOTORCYCLES AND SAFETY  
SYMPOSIUM," MELBOURNE, 1976 P59-94  
1976; 11REFS  
PRESENTED AT THE SYMPOSIUM, AUSTRALIAN RD.  
RES. CENTRE, 18 JUN 1976.  
Availability: IN HS-022 803

HS-022 807

### USER ISSUES IN MOTORCYCLE SAFETY

A DISCUSSION OF MOTORCYCLE SAFETY FROM A SYSTEMS STANDPOINT IDENTIFIES AREAS OF INFORMATION LACK AND TRACES SOME OF THESE THROUGH FROM THE VIEWPOINT OF THE MOTORCYCLE USER. THE DIFFICULTY OF MONITORING ACCIDENT LEVELS AND OF FINDING WAYS OF REDUCING THEM STEMS FROM LACK OF DATA ON MOTORCYCLE USAGE, OWNERSHIP, AND OPERATIONAL PATTERNS. AUSTRALIA AND THE U.S. TEND TO HAVE LARGER MACHINES, WHILE THE UNITED KINGDOM AND EUROPE USE MORE OF THE SMALLER, MORE ECONOMICAL MOPEDS. INSURANCE RATES REFLECT THE DECLINE IN CASUALTIES WITH AGE, OFFERING SIGNIFICANT REDUCTIONS FOR RIDERS OVER 20 YEARS OF AGE. ONE STUDY SHOWING THAT LESS THAN HALF THE ACCIDENTS INVOLVING ANOTHER VEHICLE WERE DUE TO THE MOTORCYCLIST LED TO GREATER EMPHASIS ON CONSPICUITY MEASURES: USE OF BRIGHT CLOTHING, HEADLIGHTS, HELMETS, AND SIDE REFLECTION. EDUCATION OF OTHER DRIVERS AND OF PEDESTRIANS FOR BETTER AWARENESS OF TWO-WHEELED VEHICLES IS NEEDED. MEASURES TO TRAIN THE NEW MOTORCYCLE DRIVER ARE RECOMMENDED, WITH TRAINING COURSES TO DEVELOP MOTOR SKILLS AND ROAD SENSE, CONSTRAINT IN MACHINE SIZE, TESTING, PROMOTION OF SAFETY MEASURES, DEVELOPMENT OF A GRADUATED INSURANCE SYSTEM, AND CONSISTENT ENFORCEMENT OF TRAFFIC REGULATIONS. STANDARDS FOR LICENSING THE MACHINE ITSELF ARE EFFECTIVE SAFETY MEASURES. CONTINUOUS IMPROVEMENT OF HELMETS FOR GREATER PROTECTION, AND THE DESIGNING OF OTHER VEHICLES TO PROVIDE BETTER VISION AND IMPACT SAFEGUARDS ARE URGED. SEVEN TABLES CONCERNING OPERATOR, VEHICLE, PEDESTRIAN AND WEATHER CONDITION ASPECTS OF ACCIDENTS ARE APPENDED. PROVISIONAL CASUALTY TOTALS FOR 1975 ARE ALSO TABULATED.

by M. R. WIGAN  
AUSTRALIAN ROAD RES. BOARD, AUSTRALIA  
Publ: HS-022 803, "MOTORCYCLES AND SAFETY  
SYMPOSIUM," MELBOURNE, 1976 P95-118B  
1976; 13REFS  
PRESENTED AT THE SYMPOSIUM, AUSTRALIAN RD.  
RES. CENTRE, 18 JUN 1976.  
Availability: IN HS-022 803

HS-022 808

### EVALUATION OF THE GRADED MOTORCYCLE LICENCE SCHEME IN WESTERN AUSTRALIA

THE MOTORCYCLE GRADED LICENSE SCHEME WAS INTRODUCED IN WESTERN AUSTRALIA IN MAR 1973; PRIOR TO 23 MAR 1973 ALL WHO OBTAINED A MOTORCYCLE LICENSE IN WESTERN AUSTRALIA RECEIVED A "D" CLASS LICENSE PERMITTING THEM TO RIDE A MOTORCYCLE OF ANY ENGINE CAPACITY; AFTER THAT DATE THOSE WHO PASSED A ROAD TEST ON A MACHINE WITH AN ENGINE CAPACITY NOT EXCEEDING 250 CC WERE ISSUED AN "L" CLASS LICENSE AND WERE RESTRICTED TO RIDING A MOTORCYCLE WITH ENGINE CAPACITY OF NOT MORE THAN 250 CC. NO RESTRICTIONS WERE PLACED ON "K" CLASS LICENSE HOLDERS REGARDING ENGINE SIZE, BUT THEY WERE REQUIRED TO TAKE THE ROAD TEST ON A MOTORCYCLE WITH AN ENGINE CAPACITY EXCEEDING 250 CC. BOTH THE BEFORE AND AFTER GROUPS HAD IN EXCESS OF 2500 SUBJECTS EACH. THE EXPERIMENTAL DESIGN ALSO INCORPORATED A NUMBER OF COMPARISONS TO ENABLE ANY DIFFERENCES BETWEEN THE BEFORE AND AFTER PERIODS, OR THE GROUPS OF SUBJECTS BEING COMPARED, TO BE DETECTED. NONE OF THE BEFORE/AFTER COMPARISONS ON A MOTORCYCLE ACCIDENT VARIABLE RESULTED IN SIGNIFICANT FINDINGS. WITH THE EXCEPTION THAT THE SUBJECTS IN THE AFTER GROUP WERE SLIGHTLY OLDER AND APPARENTLY SUBJECTED TO HIGHER STANDARD ROAD TESTS WHEN THEY OBTAINED THEIR MOTORCYCLE LICENSES, THE BEFORE AND AFTER PERIODS WERE VERY SIMILAR; ANY DIFFERENCES WERE OF A MINOR NATURE AND DID NOT AFFECT THE CONCLUSION OF THE STUDY, THAT INTRODUCTION OF THE GRADED LICENSE SCHEME DID NOT EFFECT A REDUCTION IN THE INCIDENCE OF MOTORCYCLE ACCIDENTS IN WESTERN AUSTRALIA.

by D. I. SMITH  
ROAD TRAFFIC AUTHORITY, RES. AND STATISTICS  
DIV., WESTERN AUSTRALIA  
Publ: HS-022 803, "MOTORCYCLES AND SAFETY  
SYMPOSIUM," MELBOURNE, 1976 P119-43  
1976; 26REFS  
PRESENTED AT THE SYMPOSIUM, AUSTRALIAN RD.  
RES. CENTRE, 18 JUN 1976. SPONSORED BY  
AUSTRALIAN DEPT. OF TRANSPORT.  
Availability: IN HS-022 803

HS-022 809

### APPROACHES TO TRAINING SUGGESTED BY A QUESTIONNAIRE SURVEY OF MOTORCYCLISTS

A MAIL QUESTIONNAIRE SURVEY IS DESCRIBED, WHICH WAS CARRIED OUT PRIMARILY TO ASSESS THE LEVEL OF PRE-LICENSE RIDING EXPERIENCE AMONG LEARNER PERMIT MOTORCYCLISTS; ATTITUDES ON MOTORCYCLE TRAINING WERE ALSO SURVEYED. OF THE ORIGINAL SAMPLE, 2600 USABLE RETURNS WERE OBTAINED, OR 81.3%. OF THESE, 2097 STATED THAT THEY HAD HAD PREVIOUS MOTORCYCLING EXPERIENCE BEFORE OBTAINING THE LEARNER PERMIT; NEARLY TWO-THIRDS OF THESE

CLASSIFIED THEIR EXPERIENCE AS OFF-ROAD. THOSE WITH ON-ROAD EXPERIENCE HAD DONE LITTLE DRIVING IN HEAVY TRAFFIC; 85% FELT THAT RIDER TRAINING WOULD REDUCE ACCIDENTS, PREFERABLY PRE-LICENSE TRAINING. THESE RESULTS SUGGEST THAT TRAINING COURSES SHOULD BE DESIGNED ON THE ASSUMPTION THAT MOST OF THE STUDENTS ALREADY KNOW THE BASICS OF MOTORCYCLE CONTROL AND MANY WILL HAVE HAD CONSIDERABLE RIDING EXPERIENCE, MOSTLY IN OFF-ROAD CONDITIONS; THUS MORE EMPHASIS SHOULD BE GIVEN TO RIDING IN TRAFFIC. A COURSE SHOULD BE GIVEN AFTER LEARNER PERMIT ISSUE AND BEFORE LICENSING, POSSIBLY A SLIGHTLY DIFFERENT COURSE FOR COUNTRY RIDERS THAN FOR CITY RIDERS.

by R. S. JAMES; J. S. BERENYI; P. M. STRANG  
ROAD SAFETY AND TRAFFIC AUTHORITY, ROAD  
CRASH RES. DIV., AUSTRALIA  
Publ: HS-022 803, "MOTORCYCLES AND SAFETY  
SYMPOSIUM," MELBOURNE, 1976 P144-56  
1976; 1REF  
PRESENTED AT THE SYMPOSIUM, AUSTRALIAN RD.  
RES. CENTRE, 18 JUN 1976.  
Availability: IN HS-022 803

HS-022 810

### **MOTORCYCLISTS' ATTITUDES TO SOME ROAD SAFETY COUNTERMEASURES**

A GROUP OF 74 MOTORCYCLISTS WAS QUESTIONED ABOUT ATTITUDES TOWARD THE COUNTERMEASURES AVAILABLE. THE DATA PROVIDED THE MOTORCYCLIST'S OPINION OF THE IMPORTANCE OF EACH COUNTERMEASURE, THE EXPOSURE OF ANY FLAWS IN THE THEORETICAL RECOMMENDATIONS FROM A PRACTICAL POINT OF VIEW, AND THE MOTORCYCLIST'S SUBJECTIVE RESPONSE TO THE COUNTERMEASURES. THOUGH THE SAMPLE SIZE IS TOO SMALL TO BE A RELIABLE INDICATION OF THE ATTITUDES OF THE ENTIRE POPULATION, SOME TENTATIVE CONCLUSIONS ARE DRAWN: THE MOST ACCEPTABLE COUNTERMEASURES ARE RIDER TRAINING AND DAYTIME USE OF HEADLIGHTS; HIGH VISIBILITY RIDING CLOTHES IS NOT A POPULAR COUNTERMEASURE AMONG THOSE WHO DO NOT ALREADY WEAR THEM; MORE RESEARCH SHOULD BE DONE ON IMPROVEMENT OF THE MOTORCYCLE HORN AND TO THE FITTING OF WHITE FAIRINGS ON NEW MOTORCYCLES; IF LICENSE RESTRICTIONS FOR INEXPERIENCED MOTORCYCLISTS CAN BE JUSTIFIED STATISTICALLY IT WOULD BE ACCEPTED; NO SUPPORT WAS GIVEN FOR RESTRICTING THE MANEUVERING OF MOTORCYCLES, I.E. PREVENTING DASHED LINE AND VERGE DRIVING.

by MARILYN WARDLE  
Publ: HS-022 803, "MOTORCYCLES AND SAFETY  
SYMPOSIUM," MELBOURNE, 1976 P157-63  
1976; 2REFS  
PRESENTED AT THE SYMPOSIUM, AUSTRALIAN RD.  
RES. CENTRE, 18 JUN 1976.  
Availability: IN HS-022 803

HS-022 811

### **MOTORCYCLE DESIGN AND SAFETY**

THE PROBLEM OF A MOTORCYCLIST IN A MIXED TRAFFIC STREAM IS OUTLINED AND THE POSSIBILITIES EXPLORED FOR DESIGN BOTH TO REDUCE THE LIKELIHOOD OF ACCIDENT (MATCHING THE MACHINE TO THE RIDER AND TO THE ROAD SURFACE, AND MATCHING THE MOTORCYCLIST TO THE OTHER TRAFFIC), AND TO MINIMIZE INJURY IN THE EVENT OF ACCIDENT. A CRASH TEST PROGRAM THE U.S. IS DESCRIBED, WHOSE OBJECTIVE WAS TO ESTABLISH THE ROLE OF THE VARIOUS ASPECTS OF MOTORCYCLE DESIGN (E.G. HANDLEBARS AND FUEL TANKS) IN PRODUCING INJURIES, AND TO PROVIDE THE SAFETY PERFORMANCE STANDARDS REQUIRED TO REDUCE OR ELIMINATE HAZARDS. A NUMBER OF CHANGES IN MOTORCYCLE DESIGN WERE RECOMMENDED, INCLUDING ALTERATIONS IN FUEL TANK DESIGN FOR REDUCTION IN FIRE HAZARD, ALTERATIONS IN WINDSHIELDS, HANDLEBARS, AND NUMEROUS OTHER ASPECTS; IN GENERAL, A SMOOTHING OF THE OUTER CONTOUR OF THE ENTIRE MOTORCYCLE TO ELIMINATE LACERATING PROJECTIONS. THOSE ASPECTS OF DESIGN WHICH ARE APPROPRIATE TO REGULATORY CONTROL ARE CONSIDERED BRIEFLY, WITH A DESCRIPTION OF THE DEVELOPMENT OF THE AUSTRALIAN DESIGN RULES AND DRAFT REGULATION AS THEY APPLY TO MOTORCYCLES, AND CONSIDERATION OF POSSIBLE FUTURE ACTION. STUDIES ARE CONTINUING ON DAYTIME USE OF HEADLAMPS AND OTHER MEANS OF IMPROVING VISIBILITY, ON MEANS OF PROVIDING LOWER LIMB PROTECTION FOR MOTORCYCLISTS, AND ON DETERMINATION OF THE TECHNICAL REQUIREMENTS FOR MOTORCYCLE STABILITY AND BRAKING.

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AUSTRALIA; MONASH UNIV., AUSTRALIA  
Publ: HS-022 803, "MOTORCYCLES AND SAFETY  
SYMPOSIUM," MELBOURNE, 1976 P164-79  
1976; 11REFS  
PRESENTED AT THE SYMPOSIUM, AUSTRALIAN RD.  
RES. CENTRE, 18 JUN 1976.  
Availability: IN HS-022 803

HS-022 812

### **PERFORMANCE OF CRASH HELMETS IN NEW SOUTH WALES [AUSTRALIA]**

THE BASIS FOR THE AUSTRALIAN STANDARD FOR HELMETS FOR VEHICLE USERS IS REVIEWED. LITERATURE ON HELMET EFFECTIVENESS IS SURVEYED, AND CONCLUSIONS RELEVANT TO THE CURRENT STUDY MENTIONED. THE TEST METHOD FOR IMPACT ENERGY ATTENUATION UNDER AMBIENT TEMPERATURE CONDITIONS IS DESCRIBED. ENERGY TEST RESULTS FOR HELMETS SOLD N.S.W., AUSTRALIA, FROM 1971 TO 1976 ARE REPORTED. COMPARISONS ARE MADE BETWEEN MANUFACTURERS' CLAIMS AND TEST RESULTS AND VALUES FOR HEAD INJURY CRITERION (HIC) AND SEVERITY INDEX ARE REPORTED. FROM THE FLAT ANVIL IMPACT ENERGY ATTENUATION TEST

EMPLOYED, IT IS CONCLUDED THAT HELMETS OF A TYPE APPROVED FOR USE BY MOTORCYCLISTS IN N.S.W. GIVE VASTLY DIFFERING DEGREES OF HEAD PROTECTION. THE TEST METHOD AND REQUIREMENTS WERE BASED ON THE EQUIVALENT TEST FROM THE AUSTRALIAN STANDARD 1698, BUT WITH MORE REALISTIC SITES IN THE ESSENTIAL TEMPLE AREA. THE BEST HELMETS WERE THOSE CERTIFIED BY THE STANDARDS ASSOC. OF AUSTRALIA TO COMPLY WITH AS 1698, AND THOSE CLAIMED TO COMPLY WITH AMERICAN NATIONAL STANDARD Z90.1-1971. APPENDED TABLES GIVE FLAT ANVIL IMPACT ENERGY RESULTS AND THE EFFECT OF LABELING ON PEAK ACCELERATION AND HIC.

by NEIL GILLIES  
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ACCIDENT RES. UNIT, N.S.W., AUSTRALIA  
Publ: HS-022 803, "MOTORCYCLES AND SAFETY  
SYMPOSIUM," MELBOURNE, 1976 P180-207  
1976; 35REFS  
PRESENTED AT THE SYMPOSIUM, AUSTRALIAN RD.  
RES. CENTRE, 18 JUN 1976. SUPPORTED BY  
COMMONWEALTH GOVERNMENT OF AUSTRALIA.  
Availability: IN HS-022 803

HS-022 813

#### **A SYSTEMATIC LOOK AT MOTORCYCLING SAFETY. GENERAL DISCUSSION**

A COMMENTARY ON THE SYMPOSIUM PAPERS AND DISCUSSION CONCLUDES THAT THEY DEAL PRIMARILY WITH ATTRIBUTES OF THE HUMAN OPERATOR AND, TO A LESSER EXTENT, HIS/HER MACHINE; ONLY 4% OF THE MATERIAL DEALS WITH THE ENVIRONMENT IN WHICH HE/SHE OPERATES. MORE RESEARCH ON ENVIRONMENTAL FACTORS IS URGED. THE VIEWS OF THREE CLASSES OF OPERATOR ARE EXAMINED AND FOUND TO DIFFER CONSIDERABLY AS TO HOW THE SYSTEM SHOULD BE CHANGED. THE MAJORITY OF MOTORCYCLE USERS ARE COMMUTERS, WHO SEE ACCIDENT AVOIDANCE AS BEST ASSURED BY RIDER ACTION OR CONDITIONING: RIDER TRAINING, DAYTIME USE OF LIGHTS, GRADED LICENSES, AND HIGH VISIBILITY JACKETS. THE BEST INFORMED ARE THOSE PARTICIPATING IN ORGANIZED MOTOR SPORT AND BELONGING TO CLUBS; THEY RATE PROBLEMS ARISING FROM THE ENVIRONMENT AS MUCH MORE NUMEROUS THAN THOSE OF RIDER BEHAVIOR, BUT ALSO LIST A NUMBER OF EQUIPMENT DEFECTS. AT THE OTHER EXTREME MOTORCYCLE GANGS SEE ALL THEIR PROBLEMS AS COMING FROM RESTRICTIONS PLACED ON THEM BY SOCIETY. SPECIAL IMPORTANCE IS ASCRIBED TO SEVEN COUNTERMEASURES: GRADED LICENSES, RIDER TESTS, PRE-LICENSE PLATE TRAINING, RIDER'S PERCEPTION OF RISK, CONSPICUITY, HELMETS, AND DESIGN OF MOTORCYCLE. FURTHER RESEARCH IS NEEDED IN THE LEGAL SYSTEM, COMMUNITY ACCEPTANCE, ENGINEERING, POLICE ATTITUDE, ROAD USER EDUCATION, AND POLICY OF INSURERS, ESPECIALLY

GOVERNMENT-CONTROLLED, THIRD-PARTY INSURERS.

by DAVID C. HERBERT  
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ACCIDENT RES. UNIT, N.S.W., AUSTRALIA  
Publ: HS-022 803, "MOTORCYCLES AND SAFETY  
SYMPOSIUM," MELBOURNE, 1976 P208-20  
1976  
PRESENTED AT THE SYMPOSIUM, AUSTRALIAN RD.  
RES. CENTRE, 18 JUN 1976.  
Availability: IN HS-022 803

HS-022 814

#### **MOTORCYCLE SAFETY: A SELECTIVELY ANNOTATED BIBLIOGRAPHY**

A BRIEFLY ANNOTATED BIBLIOGRAPHY COMPLEMENTS THE PAPER "USER ISSUES IN MOTORCYCLE SAFETY" PRESENTED AT THE AUSTRALIAN ROAD RES. BOARD/AUSTRALIAN DEPT. OF TRANSPORT SYMPOSIUM ON MOTORCYCLE SAFETY HELD AT ARRB IN JUN 1976. THE REFERENCES ARE GROUPED IN 12 CATEGORIES: SAFETY MEASURES; DATA ON ACCIDENTS--MOTORCYCLISTS, EXPOSURE AND MILEAGES; LEGISLATION; MOTORCYCLE AND MOTORCYCLE USER BEHAVIOR; MOTORCYCLE NOISE; THE MOTORCYCLE ITSELF: INSPECTION, PHYSICAL CHARACTERISTICS, VISIBILITY, AND DESIGN; MOTORCYCLES IN A TRANSPORT PLANNING CONTEXT; MOTORCYCLE ACCIDENT TRAUMA; MOTORCYCLE DRIVER LICENSING; MOTORCYCLE AIR POLLUTION FACTORS; MOTORCYCLE TRAINING; AND MOTORCYCLE HELMETS. THE HARVARD REFERENCING SYSTEM IS USED THROUGHOUT.

by M. R. WIGAN  
AUSTRALIAN ROAD RES. BOARD, AUSTRALIA  
Publ: HS-022 803, "MOTORCYCLES AND SAFETY  
SYMPOSIUM," MELBOURNE, 1976 P221-42  
1976  
PRESENTED AT THE SYMPOSIUM, AUSTRALIAN RD.  
RES. CENTRE, 18 JUN 1976.  
Availability: IN HS-022 803

HS-022 815

#### **SUMMARY OF THE AUTOMOTIVE THEFT SURVEY. A JOINT PROJECT BETWEEN GENERAL MOTORS CORPORATION AND SEVERAL AUTOMOTIVE INSURANCE COMPANIES**

A SUMMARY IS MADE OF THE DATA FROM 16,619 THEFT SURVEY REPORTS RECEIVED FROM 13 PARTICIPATING INSURANCE COMPANIES. CONCLUSIONS IN THE GENERAL SECTION ARE THAT PASSENGER CAR THEFTS OUTNUMBERED THEFTS OF LIGHT DUTY TRUCKS BY MORE THAN 6:1; PARTIAL THEFTS ACCOUNT FOR 72% OF ALL THEFTS REPORTED; TOTAL THEFTS WERE DIVIDED ALMOST EVENLY BETWEEN CASES WHEN THE VEHICLE WAS RECOVERED AND WHERE IT WAS NOT, AND WERE A SIGNIFICANTLY SMALLER PERCENTAGE OF ALL THEFTS FOR NEWER CARS (ONE TO THREE YEARS OLD); 60% OR MORE OF THE CARS RECOVERED FOLLOWING A TOTAL THEFT HAD PARTS REMOVED. THE DATA DEALING EXCLUSIVELY WITH PASSENGER

CARS INDICATED THAT IN NEARLY 60% OF THE IDENTIFIABLE TOTAL THEFTS WHERE THE CAR WAS RECOVERED THE IGNITION LOCK CYLINDER WAS DEFEATED; TOTAL THEFT WAS SUCCESSFUL IN ABOUT 77% OF CASES IN WHICH THE IGNITION LOCK CYLINDER WAS IDENTIFIED AS BEING INVOLVED; AN UNLOCKED PASSENGER COMPARTMENT WAS INDICATED IN APPROXIMATELY 15% OF THE IDENTIFIABLE CASES; MORE THAN 50% OF THE IDENTIFIABLE ENGINE COMPARTMENT THEFTS INVOLVED AN OUTSIDE HOOD RELEASE; THE FOUR MOST PREVALENT METHODS OF ACCESSING THE PASSENGER COMPARTMENT, ACCOUNTING FOR 80% OF THE ENTRIES, WERE BY LIFTING THE DOOR LOCK BUTTON, BREAKING GLASS, NORMAL ENTRY (AN UNLOCKED DOOR), AND DEFEATING THE DOOR LOCK CYLINDER. THE FOUR MOST PREVALENT METHODS OF ACCESSING THE TRUNK/CARGO COMPARTMENT (ALMOST 90% OF THE ENTRIES) WERE BY ATTACKING THE LOCK CYLINDER, PIERCING THE SHEET METAL TO GET AT THE LOCK OR ITS LINKAGE, PRYING THE SHEET METAL, AND USING THE OWNER'S KEY. IN THEFTS OF LIGHT DUTY TRUCKS, JUST OVER 50% OF THE IDENTIFIABLE TOTAL THEFTS WHERE THE TRUCK WAS RECOVERED INDICATED THAT THE IGNITION LOCK CYLINDER WAS DEFEATED; TOTAL THEFT WAS SUCCESSFUL IN ABOUT 77% OF CASES IN WHICH THE IGNITION LOCK CYLINDER WAS IDENTIFIED AS BEING INVOLVED; AN UNLOCKED PASSENGER COMPARTMENT WAS INDICATED IN ONLY 11% OF THE IDENTIFIABLE CASES; MORE THAN 90% OF THE IDENTIFIABLE ENGINE COMPARTMENT THEFTS INVOLVED AN OUTSIDE HOOD RELEASE; AND THE TWO MOST PROMINENT METHODS OF ACCESSING THE PASSENGER COMPARTMENT, ACCOUNTING FOR MORE THAN 58% OF ENTRIES, WERE PRYING THE VENT GLASS OR ASSEMBLY, AND BREAKING THE GLASS. DETAILED CONCLUSIONS ARE LIMITED TO GENERALIZATIONS SINCE INTERCOMPARISONS BETWEEN MANUFACTURERS AND MODEL YEARS, MAKE, AND MODEL CANNOT EFFECTIVELY BE MADE WITHOUT EXPOSURE DATA.

by R. W. BOAK; B. J. RILEY; C. T. TERRY  
GENERAL MOTORS CORP., DEPT. OF AUTOMOTIVE  
SAFETY ENGINEERING, WARREN, MICH. 48090  
Rept. No. EAS-036; 1978; 118P  
Availability: CORPORATE AUTHOR

HS-022 816

### COMPARATIVE EFFECTIVENESS OF OCCUPANT RESTRAINT SYSTEMS

THE SAFETY OF THREE TYPES OF OCCUPANT CRASH PROTECTION IN PASSENGER CARS IS COMPARED: PASSIVE RESTRAINTS, CONVENTIONAL HARNESES, AND CRASH-ACTUATED HARNESES. IN ADDITION, A LIMITED CRITIQUE IS MADE OF FIVE REPORTS ON LABORATORY STUDIES. THE COMPARISON OF RESTRAINT SYSTEMS FOCUSED ON FIELD TRIAL EXPERIENCE SINCE THIS IS THE MOST RELIABLE INDICATION OF PERFORMANCE; AS THERE IS NO FIELD EXPERIENCE WITH CRASH ACTUATED HARNESES, A COMPARISON OF THIS SYSTEM WITH CONVENTIONAL AND PASSIVE HARNESES MUST RELY ON

LABORATORY TRIALS. BECAUSE OF THE DIFFERENT TEST PROTOCOLS OF THE VARIOUS STUDIES IT IS DIFFICULT TO OBTAIN A RELIABLE ESTIMATE OF THE RELATIVE PERFORMANCE OF DIFFERENT RESTRAINT SYSTEMS WHEN THEY ARE EVALUATED BY DIFFERENT LABORATORIES. DIFFICULTY IN SIMULATING CRASHES MAY RESULT IN ADEQUATE PERFORMANCE BY A RESTRAINT SYSTEM IN LABORATORY CRASHES BUT NOT IN REAL WORLD CRASHES. BECAUSE OF THE AIRBELT'S RATED DEPLOYMENT TIME, ITS FORCE-LIMITED ANCHORAGE, AND THE FACT THAT THE INFLATED TORSO SUPPORTS THE HEAD AND RESULTS IN LOWER LOWER BODY CONTACT PRESSURES THAN CONVENTIONAL BELT SYSTEMS, IT HAS THE POTENTIAL FOR THE LOWEST INJURY LEVELS OF ANY RESTRAINT SYSTEM. SEATBELT SYSTEMS OFFER AN EFFECTIVE AND LOW COST SAFETY SYSTEM; ADDITIONAL RESEARCH COULD DEVELOP OPTIMIZED SYSTEMS TO INCREASE PROTECTION AND COMFORT. MANDATED CRASH-ACTUATED, FORCE-LIMITED HARNESES PROVIDE SAFETY BENEFITS WITH RESPECT TO MANDATED HARNESES WHICH IN TURN ARE SAFER THAN MANDATED AIR BAGS.

by LAWRENCE GOLDMUNTZ; HOWARD P. GATES  
ECONOMICS AND SCIENCE PLANNING, INC., 1200  
18TH ST., N.W., SUITE 610, WASHINGTON, D.C. 20036  
1977; 31P IREF  
Availability: CORPORATE AUTHOR

HS-022 817

### THE PERFORMANCE OF CONVENTIONAL AND ENERGY ABSORBING RESTRAINTS IN SIMULATED CRASH TESTS

DYNAMIC TESTS WERE PERFORMED, USING GENERAL MOTORS HOLDEN'S "HYGE" CRASH STRIP LATOR, ON CONVENTIONAL LAP SASH SEATBELT RESTRAINTS AND OF ASSEMBLIES INCORPORATING ENERGY ABSORBERS IN THE SASH STRIP. INCLUDED IN THE TESTS WERE THREE RESTRAINT GEOMETRIES, RIGID AND CUSHIONED SEATS, ASSEMBLIES WITH THE STRAPS SLACK, TIGHT, PRELOADED. TESTS WITH A CONVENTIONAL SEATBELT INDICATED THAT THE FORCES IN THE RESTRAINT COULD REACH THE TYPICAL DECELERATION ULTIMATE LOADS FOR LIGHT AIRCRAFT, ABOUT 10 G PER SECOND PER SECOND, CORRESPONDING TO THE ENERGY ABSORBERS IN THE RESTRAINT WOULD ALLOW THE SYSTEM TO WITHSTAND CRASH DECELERATIONS OF GREATER SEVERITY WITH AN INCREASE IN THE RESTRAINT FORCES. INCORPORATION OF AN ENERGY ABSORBER INTO THE SASH STRIP OF A RESTRAINT SYSTEM REDUCED THE LOAD ON THAT STRAP TO HALF THE LOAD DEVELOPED IN A CONVENTIONAL CONFIGURATION WHEN TESTED WITH THE SAME ACCELERATION PULSE, THREE-POINT AND FOUR-POINT TEST SYSTEMS ON SOFT OR RIGID SEATS DEVELOPED PROXIMATELY THE SAME LOAD. HIGH LOADS WERE



DEVELOPED BETWEEN THE DUMMY AND THE SEAT FRAME IN TESTS USING A CUSHIONED SEAT.

by S. R. SARRAILHE; N. D. HEARN  
AUSTRALIAN DEFENCE SCIENTIFIC SERVICE,  
AERONAUTICAL RES. LABS., P.O. BOX 4331,  
MELBOURNE, VIC. 3001, AUSTRALIA  
Rept. No. ARL/STRUC-359; ADA047532; 1975; 40P 7REFS  
Availability: CORPORATE AUTHOR

HS-022 818

## **DRIVERS' JUDGMENTS OF SAFE DISTANCES IN VEHICLE FOLLOWING**

DRIVER BEHAVIOR IN THE VEHICLE-FOLLOWING SITUATION, A MAJOR SOURCE OF ROAD ACCIDENTS, WAS INVESTIGATED USING A CONTROLLED-TRACK EXPERIMENT. DRIVERS WERE FOUND TO ADOPT HEADWAYS OF APPROXIMATELY 2 SECONDS, IRRESPECTIVE OF SPEED OF TRAVEL, DRIVING EXPERIENCE, OR INSTRUCTED PROBABILITY OF THE LEADING VEHICLE'S STOPPING. UNDER THE OPTIMAL CONDITIONS USED, DRIVERS DEMONSTRATED THAT SUCH HEADWAYS WERE MORE THAN ADEQUATE TO AVOID TAIL-END COLLISIONS IN AN EMERGENCY SITUATION. THE FINDINGS SUGGEST THAT HEADWAY JUDGMENT IS ADEQUATE UNDER IDEAL WEATHER CONDITIONS, BUT THAT PERCEPTUAL-MOTOR SUPPORT DEVICES AND OTHER METHODS TO PREVENT CLOSE FOLLOWING WILL HAVE A SIGNIFICANT ROLE IN OVERALL ACCIDENT PREVENTION. A REAR-MOUNTED DEVICE IS SUGGESTED FOR SIGNALLING DECELERATION SEPARATELY FROM THE DRIVER'S BRAKING RESPONSE. IT IS POSTULATED THAT THE DRIVER'S MAIN PROBLEM IN SAFE FOLLOWING DERIVES FROM DIFFICULTY IN EVALUATING RISK AND HAZARD RATHER THAN FROM THE LIMITATIONS ON HIS SENSORY AND PERCEPTUAL ABILITIES.

by CHRISTOPHER J. COLBOURN; IVAN D. BROWN;  
ALAN K. COPEMAN  
Publ: HUMAN FACTORS V20 N1 P1-11 (FEB 1978)  
1978; 30REFS  
SUPPORTED BY UNITED KINGDOM DEPT. OF THE ENVIRONMENT AND BY MEDICAL RES. COUNCIL OF GREAT BRITAIN.  
Availability: SEE PUBLICATION

HS-022 819

## **INDIVIDUAL DIFFERENCES AND THE PERCEPTION OF TRAFFIC SIGNS**

THE RELATIONSHIP WAS INVESTIGATED BETWEEN FIELD DEPENDENCE AND THE ABILITY TO PERCEIVE TRAFFIC SIGNS IN EMBEDDED AND DISEMBEDDED CONTEXTS AS MEASURED BY VERBAL REACTION TIMES. INTERCORRELATIONS AMONG THE REACTION TIMES, PERSONALITY MEASURES, AND DRIVING RECORD ITEMS WERE ALSO TESTED. TWENTY-EIGHT FEMALES WERE BLOCKED INTO FOUR QUANTILES ACCORDING TO THEIR SCORE ON THE GROUP EMBEDDED FIGURES TEST. SUBJECTS COMPLETED THE TRAFFIC-SIGN TASK, THE EYSENCK PERSONALITY INVENTORY, AND A DRIVING EXPERIENCE QUESTIONNAIRE. FIELD-DEPEN-

DENT SUBJECTS HAD LONGER REACTION TIMES TO EMBEDDED TRAFFIC SIGNS AND MORE TRAFFIC ACCIDENTS THAN DID FIELD-INDEPENDENT SUBJECTS. ALSO, EXTRAVERTS HAD LONGER REACTION TIMES TO THE EMBEDDED TRAFFIC SIGNS, MORE ACCIDENTS, AND MORE TRAFFIC CONVICTIONS THAN INTROVERTS. NO RELATIONSHIPS WERE FOUND FOR NEUROTICISM.

by ROBERT LOO  
Publ: HUMAN FACTORS V20 N1 P65-74 (FEB 1978)  
1978; 16REFS  
Availability: SEE PUBLICATION

HS-022 820

## **EFFECTIVENESS OF AUDIBLE WARNING SIGNALS FOR EMERGENCY VEHICLES [DRIVER RESPONSE]**

TWENTY-FOUR SUBJECTS ENGAGED IN A SIMULATED DRIVING TASK DETECTED AUDIBLE WARNING SIGNALS OF THE SORT COMMONLY USED BY EMERGENCY VEHICLES. THE SIMULATED DRIVING TASK, CARRIED OUT IN AN INSTRUMENTED CAR UNDER COMPUTER CONTROL, INCLUDED STEERING TOWARD ALTERNATELY ILLUMINATED FENDER LIGHTS AND MAINTAINING A CONSTANT SPEEDOMETER READING. THE REQUIRED DETECTION RESPONSE WAS DEPRESSION OF THE BRAKE PEDAL. TO A FIRST APPROXIMATION, SIGNALS OF EQUAL DETECTABILITY WERE EQUALLY EFFECTIVE IN ELICITING BRAKING RESPONSES FROM PEOPLE ENGAGED IN ACTIVITY UNRELATED TO SIGNAL DETECTION.

by SANFORD FIDELL  
Publ: HUMAN FACTORS V20 N1 P19-26 (FEB 1978)  
1978; 12REFS  
RESEARCH CONDUCTED UNDER CONTRACT TO SOCIETY OF AUTOMOTIVE ENGINEERS.  
Availability: SEE PUBLICATION

HS-022 821

## **RIGHT-TURN-ON-RED. VOL. 1. FINAL TECHNICAL REPORT**

OBJECTIVES OF THIS STUDY WERE TO DETERMINE WHETHER PERMITTING RIGHT-TURN-ON-A-RED TRAFFIC SIGNAL (RTOR) IS DESIRABLE AND TO PREPARE GUIDELINES FOR DETERMINING INCLUSION OR EXCLUSION OF THIS MOVEMENT. THE SCOPE INCLUDED FIELD DATA COLLECTION AND COMPUTER SIMULATION ANALYSES, ACCIDENT ANALYSES, DRIVER AND PEDESTRIAN ATTITUDE SURVEYS, LEGAL AND LAW ENFORCEMENT ANALYSES, AND SIGNING NEEDS EVALUATION. THE RESULTS OF THE VARIOUS STUDIES SUPPORT THE ADOPTION OF THE GENERALLY PERMISSIVE RTOR RULE BY ALL STATES. SIGNIFICANT BENEFITS IN THE FORM OF REDUCED DELAY, FUEL CONSUMPTION, AND AUTO EMISSIONS CAN BE REALIZED WITHOUT SACRIFICING SAFETY. INCLUDED IN THE REPORT ARE IMPLEMENTATION GUIDELINES AND RECOMMENDED CHANGES TO THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES. THE



HS-022 822

HSL 78-09

COMPLETE DOCUMENTATION OF THE TECHNICAL STUDIES AND RECOMMENDATIONS IS APPENDED.

by H. W. MCGEE; W. A. STIMPSON; J. COHEN; G. F. KING; R. F. MORRIS  
ALAN M. VOORHEES AND ASSOCIATES, INC.,  
MCLEAN, VA.; KLD ASSOCIATES, INC., HUNTINGTON  
STATION, N.Y.  
FH-11-8251  
Rept. No. FHWA-RD-76-89; PB-262 255; 1976; 246P 75REFS  
REPT. FOR FEB 1974-MAY 1976. VOL. 2, SUMMARY  
REPT., IS HS-022 822.  
Availability: NTIS

HS-022 822

### **RIGHT-TURN-ON-RED. VOL. 2. EXECUTIVE SUMMARY**

by H. W. MCGEE; W. A. STIMPSON; J. COHEN; G. F. KING; R. F. MORRIS  
ALAN M. VOORHEES AND ASSOCIATES, INC.,  
MCLEAN, VA.; KLD ASSOCIATES, INC., HUNTINGTON  
STATION, N.Y.  
FH-11-8251  
Rept. No. FHWA-RD-76-90; PB-262 256; 1976; 25P  
REPT. FOR FEB 1974-MAY 1976. FOR ABSTRACT, SEE  
HS-022-821.  
Availability: NTIS

HS-022 823

### **THE ROLE OF THE MOTOR VEHICLE IN MODERN INDUSTRIAL ECONOMIES**

THE ROLE OF MOTOR VEHICLES IN MODERN INDUSTRIAL ECONOMIES INCLUDES THAT OF THE PRINCIPAL MEANS OF PERSONAL TRANSPORTATION, A MAJOR AND GROWING MEANS OF GOODS TRANSPORT, AND A SOURCE OF EMPLOYMENT FOR OVER 30 MILLION PERSONS IN THE MOTOR VEHICLE MANUFACTURING NATIONS OF THE ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT. MOTOR VEHICLES ARE ALSO A MAJOR FACTOR IN INTERNATIONAL TRADE. THE MOTOR VEHICLE IS CENTRAL TO A LIFESTYLE BASED ON PERSONAL FREEDOM AND MOBILITY, AND TO THE ECONOMIC DEVELOPMENT UPON WHICH SUCH A LIFESTYLE DEPENDS. IN ORDER TO DEAL WITH AN INCREASING SHORTAGE OF FOSSIL FUELS, IT IS RECOMMENDED THAT THE OPERATION OF THE MARKETPLACE BE RELIED UPON TO ACHIEVE A REDUCTION IN FUEL CONSUMPTION, THAT INTERNATIONAL VEHICLE CONSTRUCTION STANDARDS BE ADOPTED WHERE MARKET CONSTRAINTS ARE NOT ADEQUATE, THAT ALTERNATE FUELS BE CONSIDERED, AND THAT PUBLIC TRANSPORTATION AND NEW HIGHWAY CONSTRUCTION BE SUBSIDIZED TO AVOID CONGESTION. ATTEMPTS ARE RECOMMENDED TO ACHIEVE THE BEST OVERALL MIX OF AVAILABLE FACILITIES TO MEET THE TRANSPORTATION NEEDS OF PERSONS LIVING AND WORKING IN A GIVEN AREA. GOVERNMENT AND INDUSTRY COOPERATION IS NEEDED TO ACHIEVE THE RECOMMENDED OBJECTIVES.

BUREAU PERMANENT INTERNATIONAL DES  
CONSTRUCTEURS D'AUTOMOBILES, STUDY COM.

FOR THE MOTOR VEHICLE IN SOCIETY, 4, RUE DE  
BERRI, 75008 PARIS, FRANCE  
1977; 24P 29REFS  
Availability: CORPORATE AUTHOR

HS-022 824

### **DEVELOPMENT OF REVISED LIGHT-DUTY-VEHICLE EMISSION - AVERAGE SPEED RELATIONSHIPS**

A STATISTICAL ANALYSIS WAS PERFORMED OF THE GENERAL MOTORS CHASE-CAR DATA, AND REGRESSIONS OF FUEL CONSUMPTION AND EMISSIONS WERE ESTABLISHED ON AVERAGE SPEED OVER DRIVING CYCLES GENERATED FROM GENERAL MOTORS AND CAPE-10 DATA. TEN CYCLES WERE SELECTED AT EACH OF 11 NOMINAL SPEEDS RANGING FROM 5 MPH TO 55 MPH. HOT-START ESTIMATES OF HYDROCARBONS, CARBON MONOXIDE, AND NITROGEN OXIDES (ALL IN UNITS OF GRAMS PER MILE), AND FUEL CONSUMPTION (IN UNITS OF MILES PER GALLON) OVER EACH OF THE CYCLES WERE OBTAINED FOR EACH OF 18 MODEL-YEAR GROUPS. THE EMISSIONS AND FUEL CONSUMPTION ESTIMATES WERE REGRESSED ON AVERAGE SPEED TO YIELD THE DESIRED EMISSION-AVERAGE SPEED RELATIONSHIP FOR EACH MODEL-YEAR GROUP. THE EQUATIONS WERE THEN NORMALIZED TO 19.6 MPH, THE AVERAGE SPEED OVER THE FEDERAL TEST PROCEDURE (FTP) CYCLE, TO YIELD CORRECTION-FACTOR EQUATIONS. GROUPS WERE COMBINED TO GIVE COMPOSITE CORRECTION-FACTOR EQUATIONS FOR 1975 VEHICLE POPULATION IN LOW-ALTITUDE CITIES AND FOR 1974 VEHICLE POPULATION IN HIGH-ALTITUDE CITIES. THE METHODOLOGY WAS FOUND TO PROVIDE RELIABLE EMISSIONS/FUEL ECONOMY/AVERAGE SPEED RELATIONSHIPS FOR ANALYZING THE ENVIRONMENTAL IMPACT OF VARIOUS MIXES OF LIGHT DUTY VEHICLES.

by MALCOLM SMITH; TOM ALDRICH  
OLSON LABS., INC., 421 E. CERRITOS AVE., ANAHEIM,  
CALIF. 92805  
68-03-2222  
Rept. No. EPA-460/3-77-011; PB-275 763; 1977; 254P 6REFS  
Availability: NTIS

HS-022 825

### **AUTO HEADLIGHT GLASS: VISIBLE FEATURES OF FORENSIC UTILITY**

THOSE VISIBLE FEATURES OF SEALED BEAM AUTO HEADLIGHTS ARE DOCUMENTED WHICH MAY BE USEFUL IN CRIMINAL INVESTIGATIONS, INCLUDING FLUTING PATTERN, LAMPMAKER OR AUTOMAKER LOGO, AND MARKINGS FOR MOLD, PLUNGER, LENS, AND BEAM TYPE. OTHER FEATURES ARE CURVATURE, TYPE OF AIMING PAD, REFLECTOR MARKINGS, AND COLOR. GENERAL INFORMATION IS PRESENTED CONCERNING THE COMPANIES THAT MANUFACTURE SEALED-BEAM HEADLIGHTS, THE PROCESS OF MANUFACTURE, AND GENERAL PRODUCTION DATA. LENS PATTERNS ARE ILLUSTRATED BY PHOTOGRAPHS AND DRAWINGS, AND

PRODUCTION DATA TABULATED. THE DATA PRESENTED ARE CURRENT THROUGH 1974.

by HAROLD L. STEINBERG  
NATIONAL BUREAU OF STANDARDS, LAW  
ENFORCEMENT STANDARDS LAB., WASHINGTON,  
D.C. 20234

Rept. No. NBS-SP-480-17; 1978; 140P  
PREPARED FOR LAW ENFORCEMENT ASSISTANCE  
ADMINISTRATION, NATIONAL INST. OF LAW  
ENFORCEMENT AND CRIMINAL JUSTICE,  
WASHINGTON, D.C. 20531.  
Availability: GPO STOCK NO. 003-003-01857-1 \$3.00

HS-022 831

**RELATIONSHIPS BETWEEN THE ENERGY  
DENSITY FUNCTION AND DECELERATIONS IN  
THE CASE OF HEAD-ON COLLISIONS OF BUSES  
(DIE BEZIEHUNGEN ZWISCHEN DER  
ENERGIEDICHTEFUNKTION UND DEN  
VERLANGSAMUNGEN BEI FRONTALEN  
ZUSAMMENSTOSSEN VON AUTOBUSSEN)**

THE ENERGY DENSITY FUNCTION HELPS TO EXPLAIN THE LARGE DECELERATIONS WHICH ARISE DURING HEAD-ON BUS COLLISIONS. LONGITUDINAL SUPPORTS ON BUSES ARE VERY RIGID, THEIR DEFORMATION CAPACITY IS SMALL, AND THE LARGE MASS OF A BUS REDUCES THE CRITICAL SHOCK SPEED TO A VALUE MUCH SMALLER THAN THAT FOR A PASSENGER CAR. PROPOSALS ARE MADE CONCERNING THE DEVELOPMENT OF A SAFETY BUMPER STRUCTURE. THE RIGIDITY OF THE LONGITUDINAL SUPPORTS OF A BUS SHOULD BE SELECTED TO UNDERGO APPROPRIATE DEFORMATION WITHOUT LOSING THEIR ABILITY TO ABSORB THE KINETIC ENERGY OF THE BUS WHILE CHANGING SHAPE.

by CSABA MOLNAR  
1975; 26P 4REFS  
PRESENTED AT SIXTH MEETING OF BUS EXPERTS,  
SCIENTIFIC SOCIETY OF THE ENGINEERING  
INDUSTRY, BUDAPEST, 20-23 OCT 1975. TEXT ALSO IN  
GERMAN.  
Availability: TECHTRAN CORP., P.O. BOX 729, GLEN  
BURNIE, MD.

HS-022 832

**STRENGTH PROBLEMS OF BUS SEATS AND SEAT  
MOUNTS (FESTIGKEITSPROBLEME DER  
OMNIBUSSITZE UND SITZBEFESTIGUNGEN)**

IN A CONTINUATION OF BUS SEAT TESTS, THE SAME NATURE AND LOADING FORCES WERE OBSERVED AND THE MAGNITUDE OF DAMAGE WAS APPROXIMATELY THE SAME AS IN PREVIOUS TESTS. STATIC STUDIES AND PENDULUM IMPACT TESTS WERE CONDUCTED ON STANDARD AND LUXURY SEATS, PENDULUM TESTS BEING CONSIDERED SIMPLER AND LESS EXPENSIVE THAN DYNAMIC SLED TESTS. FOR CONTINUOUS DECELERATION, THE RESULTS OF ENERGY ABSORPTION TESTS CONDUCTED AT THE AUTOCUT RES. INST. WITH THIN-WALLED RECTANGULAR TUBES MAY BE USED. THESE TUBES PRO-

VIDE KNOWN DEFORMATION DATA WHICH MAY BE INCORPORATED INTO A SEAT FRAME. A SAFETY SEAT CAN BE DEVELOPED WITH A PREDICTABLE BACKREST MOVEMENT. IT IS RECOMMENDED THAT PASSENGER SEATS SHOULD HAVE FIRM STRENGTH STANDARDS AND THAT RESEARCH SHOULD FOCUS ON PREVENTING SEAT-CAUSED INJURY.

by LASZLO IMECS  
1975; 25P 13REFS  
PRESENTED AT SIXTH MEETING OF BUS EXPERTS,  
SCIENTIFIC SOCIETY OF THE ENGINEERING  
INDUSTRY, BUDAPEST, 20-23 OCT 1975. TEXT ALSO IN  
GERMAN.  
Availability: TECHTRAN CORP., P.O. BOX 729, GLEN  
BURNIE, MD.

HS-022 833

**HUNGARIAN RESEARCH ON THE STRENGTH OF  
BUS ROOFS (VORSCHUNGSARBEIT IN UNGARN  
BEZUGLICH DER DACHFESTIGKEIT VON  
OMNIBUSSEN)**

HUNGARIAN RESEARCH ON THE ROOF STRENGTH OF COMMERCIAL BUSES IN AN EFFORT TO EVALUATE THE PROTECTION AFFORDED PASSENGERS, PARTICULARLY IN ROLLOVER ACCIDENTS, IS SUMMARIZED. ON THE BASIS OF FINDINGS FROM REAL ACCIDENTS, THE STANDARD ROLLOVER ACCIDENT IS DEFINED, AS WELL AS PROCEDURES FOR ITS SIMULATION AND THE STRENGTH REQUIREMENT FOR LIMITED DEFORMATION OF THE SUPERSTRUCTURE. THE EFFECTS OF DIFFERENT VARIABLES ARE ANALYZED, AND A LABORATORY TEST METHOD IS SUGGESTED WHICH IS SUITABLE FOR SIMULATION OF THE COMPLEX ROLLOVER ACCIDENT (E.G. DRIVING OFF AN OVERPASS OR BRIDGE) VERSUS THE STANDARD ACCIDENT (OVERTURNING OFF THE SIDE OF A LEVEL ROAD). ON THE BASIS OF THE RESEARCH DESCRIBED, ROLLBARS HAVE BEEN INSTALLED AND ARE IN USE IN MOST HUNGARIAN COMMERCIAL BUSES.

by VOITH ANDRAS; VESSEY TAMAS  
1977?; 25P 13REFS  
TEXT ALSO IN GERMAN. SUMMARIES IN  
HUNGARIAN, GERMAN, ENGLISH, AND FRENCH.  
Availability: TECHTRAN CORP., P.O. BOX 729, GLEN  
BURNIE, MD.

HS-022 834

**A PROBLEM OF GROWING CONCERN: EMI  
[ELECTROMAGNETIC INTERFERENCE]**

THE RAPIDLY GROWING PROBLEM OF ELECTROMAGNETIC INTERFERENCE (EMI) IN THE ENVIRONMENT IS BEING INVESTIGATED BY THE NATIONAL BUREAU OF STANDARDS (NBS). THE SOURCES OF ELECTROMAGNETIC (EM) RADIATION IN THE ATMOSPHERE ARE SUCH THINGS AS RADAR INSTALLATIONS AT AIRPORTS, RADIO AND TELEVISION BROADCASTING TOWERS, CB (CITIZEN'S BAND) AND MOBILE RADIOS, AND SENSORS BURIED IN THE ROADWAYS THAT TELL THE TRAFFIC LIGHTS WHEN TO CHANGE. THE PROLIFERATION OF EM RADIA-

TION IN THE ENVIRONMENT RESULTS IN INTERFERENCE WITH ALL TYPES OF ELECTRONIC EQUIPMENT (E.G. LARGE COMPUTERS, TV SETS, AND HEART PACEMAKERS). WHERE THE ELECTRONIC DEVICES ARE USED TO CONTROL A VITAL FUNCTION, SUCH AS REGULATION OF THE HEARTBEAT, EMI CAN BE DANGEROUS. THE EMI PROBLEM PROMISES TO CONTINUE TO GROW, PARTICULARLY IN THE AUTOMOTIVE INDUSTRY, AS MECHANICAL PARTS AND DEVICES ARE REPLACED WITH ELECTRONIC COMPONENTS. MICROPROCESSOR-BASED SYSTEMS WILL BE PROGRAMMED TO MINIMIZE EXHAUST POLLUTANTS, MANAGE FUEL CONSUMPTION, ADVANCE THE SPARK, MONITOR SAFETY FUNCTIONS, OPTIMIZE TRANSMISSION SHIFTING, AND TRIGGER AIR BAGS. NBS HAS UNDERTAKEN THE DIFFICULT TASK OF DEVELOPING METHODS TO MEASURE BOTH THE IMPACT OF ELECTRONIC COMPONENTS ON THE EM ENVIRONMENT AND OF THE ENVIRONMENT ON THE COMPONENTS. SOME OF THE PROBLEMS IN APPROACHING THE EMI SITUATION INCLUDE THE FOLLOWING: EXTREME DIFFICULTY IN MEASURING ELECTROMAGNETIC WAVES IN THE NEAR FIELD; EXISTENCE OF MANY INTERFERING SIGNALS; AND THE CONSTANT MOVING OF ELECTRONIC COMPONENTS, PARTICULARLY THOSE USED IN MOTOR VEHICLES, FROM ONE ELECTROMAGNETIC ENVIRONMENT TO ANOTHER. THE ENVIRONMENTAL PROTECTION AGENCY (EPA) AND THE DEPT. OF TRANSPORTATION (DOT), IN PARTICULAR, ARE INTERESTED IN MEASURING THE SOURCES AND AMOUNT OF ELECTROMAGNETIC RADIATION IN THE ENVIRONMENT. EPA IS INTERESTED IN DEVELOPING A DATA BASE ON ELECTROMAGNETIC RADIATION FOR MAJOR U.S. CITIES; DOT IS INTERESTED IN MEASURING THE EM ENVIRONMENT AROUND VEHICLES TO DEFINE TYPICAL SERIOUS CONDITIONS TO WHICH AUTOMOBILES WILL BE EXPOSED. IN ITS WORK FOR DOT, THE NBS ELECTROMAGNETICS DIV. PERFORMED ON-SITE MEASUREMENT STUDIES UTILIZING SPECIALLY DESIGNED INSTRUMENTATION NEAR VEHICLES THAT WERE EQUIPPED WITH MOBILE RADIOS. THE STUDY SHOWED THAT THE NEAR-FIELD EM ENVIRONMENT WAS HIGHER THAN THE CURRENTLY ACCEPTED U.S. STANDARD FOR EM RADIATION EXPOSURE. WORKING FOR THE FEDERAL AVIATION ADMINISTRATION (FAA), NBS HAS BEEN DEVELOPING EM MEASUREMENT INSTRUMENTATION, METHODOLOGY, AND DATA. ANOTHER NBS CONTRIBUTION HAS BEEN THE DEVELOPMENT OF THE TRANSVERSE ELECTROMAGNETIC (TEM) CELL, A LARGE "CLEAN ROOM" WHERE ELECTRONIC MACHINES AND COMPONENTS CAN BE TESTED FOR SUSCEPTIBILITY TO KNOWN SOURCES OF EMI OR FOR EM OUTPUT.

by FREDERICK P. MCGEHAN  
 Publ: DIMENSIONS V62 N3 P2-7 (MAR 1978)  
 1978  
 Availability: SEE PUBLICATION

HS-022 835

## **FIRE DATA METHODOLOGY: VOL. 2. ESTIMATION OF FIRE INCIDENTS. FINAL REPORT**

IN AN EFFORT TO EXTRAPOLATE DATA FROM THE FEW STATES PRESENTLY SUPPLYING FIRE INCIDENT DATA TO THE NATIONAL FIRE INCIDENT REPORTING SYSTEM (NFIRS) TO A NATIONAL TOTAL, A FIRE DATA METHODOLOGY WAS DEVELOPED. CAUTION IS NEEDED WHEN ATTEMPTING SUCH EXTRAPOLATIONS AND ATTEMPTS TO OBTAIN EXTERNAL VALIDATION ARE IN ORDER. THE NFIRS WAS CREATED TO SUPPLY THE NATIONAL FIRE PREVENTION AND CONTROL ADMINISTRATION'S FIRE DATA CENTER WITH THE DATA NEEDED TO ACCURATELY ASSESS THE MAGNITUDE OF THE NATIONAL FIRE PROBLEM, ASSIGN PRIORITIES, AND DEVELOP AND IMPLEMENT EFFECTIVE COUNTERMEASURES TO REDUCE THE PROPERTY LOSS, INJURIES, AND DEATHS CAUSED BY FIRES. THE NFIRS WORKS IN COOPERATION WITH THE STATES WHICH COLLECT AND COMPUTERIZE THE DATA FROM THEIR FIRE DEPARTMENT RECORDS AND THEN SUBMIT THEM TO THE NFIRS. THE NFIRS, HOWEVER, IS STILL IN THE DEVELOPMENT STAGE, WITH GROUPS OF STATES BEING ADDED EACH YEAR. TO ILLUSTRATE THE METHODOLOGY DEVELOPED IN THIS STUDY, FIRE DEPARTMENT DATA FROM THE STATE OF MICHIGAN WERE USED TO DEVELOP A PREDICTIVE MODEL RELATING FIRE DATA TO SEVERAL CENSUS VARIABLES. THE RESULTING MODEL CAN BE COMBINED WITH CENSUS DATA TO OBTAIN PROJECTED FIRE RATES FOR ADDITIONAL AREAS OR FOR THE U.S. INSURANCE CLAIM RECORDS WERE USED IN AN ATTEMPT TO VALIDATE THE MODEL. DETAILED FIRE DEPARTMENT DATA FOR MICHIGAN AND CONCEPTUAL PROBLEMS WITH FIRE DEPARTMENT REPORTING SYSTEMS ARE SUMMARIZED. THESE PROBLEMS INCLUDE NONREPORTING OF SOME FIRES AND SOME FIRE INJURIES, LACK OF DETAIL, AND NEED FOR AN OPERATIONAL DEFINITION OF "FIRE." SUPPLEMENTAL SAMPLING IS RECOMMENDED TO VALIDATE AND TO SUPPLEMENT THE FIRE DEPARTMENT DATA. THREE NATIONAL SAMPLING PLANS (USING EXISTING FIRE DEPARTMENT PERSONNEL, FIELD DATA COLLECTORS, AND FIELD FIRE INVESTIGATORS) ARE SUGGESTED AS POSSIBLE APPROACHES TO OBTAINING MORE TIMELY AND DETAILED NATIONAL DATA.

by JAIRUS D. FLORA, JR.; LILY CH. HUANG; LARRY D. ROY; PETER COOLEY  
 UNIVERSITY OF MICHIGAN, HWY. SAFETY RES.  
 INST., ANN ARBOR, MICH. 48109  
 Rept. No. UM-HSRI-77-36-2; 1977; 89P 4REFS  
 SPONSORED BY NATIONAL FIRE PREVENTION AND CONTROL ADMINISTRATION, WASHINGTON, D.C.  
 20230.  
 Availability: CORPORATE AUTHOR

HS-022 836

# **AUTOMOTIVE INDUSTRY EFFORT SINCE FEBRUARY, 1976 TO COMPLY WITH A 2.0 G/TEST EVAPORATIVE EMISSION LEVEL**

PROGRESS MADE BY THE AUTOMOTIVE INDUSTRY IN ACHIEVING EVAPORATIVE EMISSION LEVELS OF LESS THAN 2 G/TEST SINCE THE 13 JAN 1976 PUBLICATION OF A NOTICE OF PROPOSED RULE MAKING (NPRM) FOR EVAPORATIVE EMISSION FROM 1978 AND 1979 MODEL YEAR LIGHT-DUTY VEHICLES AND TRUCKS (6.0 G/TEST FOR 1978 MODELS AND 2.0 G/TEST FOR 1979 MODELS), IS SUMMARIZED. IT APPEARS THAT THERE HAS GENERALLY BEEN VERY LITTLE MANUFACTURER DEVELOPMENT EFFORT TARGETED TO MEET A 2.0 G/TEST EVAPORATIVE EMISSION LEVEL. BY LETTER, 13 MANUFACTURERS (AMERICAN MOTORS, BRITISH LEYLAND, CHRYSLER, FIAT, FORD, GENERAL MOTORS, INTERNATIONAL HARVESTER, MERCEDES-BENZ, NISSAN, TOYO KOGYO, TOYOTA, VOLKSWAGEN, AND VOLVO) WERE ASKED TO SUPPLY UP-TO-DATE INFORMATION REGARDING THEIR EFFORTS SINCE THEY SUBMITTED COMMENTS ON THE NPRM. SEVEN OF THESE MANUFACTURERS (BRITISH LEYLAND, CHRYSLER, FORD, GENERAL MOTORS, TOYO KOGYO, TOYOTA, AND VOLVO) RESPONDED. OF THESE SEVEN ONLY ONE DOMESTIC MANUFACTURER (FORD) STATED THAT IT WAS ENGAGED IN A DEVELOPMENT PROGRAM AIMED AT DESIGNING A CONTROL SYSTEM WHICH WOULD MEET A 2.0 G/TEST STANDARD. TO DATE, FORD HAS NOT CONDUCTED ANY VEHICLE TESTS IN THIS PROGRAM. HOWEVER, FORD'S TESTS ON 21 VEHICLES EQUIPPED WITH THE 1978 CONTROL SYSTEM DID SHOW THAT SIX OF THESE VEHICLES HAD EVAPORATIVE LEVELS LESS THAN 2.0 G/TEST. ONE FOREIGN MANUFACTURER (VOLVO) IS DOING DEVELOPMENT AND TESTING TO ACHIEVE VERY LOW EVAPORATIVE LEVELS. LARGELY DUE TO THE CONFIGURATION OF THE VOLVO ENGINE FUEL SYSTEM (FUEL INJECTION), EVAPORATIVE LEVELS LESS THAN 2.0 G/TEST HAVE BEEN ACHIEVED ON ALL FIVE VEHICLES ON WHICH TEST DATA HAVE BEEN SUBMITTED.

by MICHAEL W. LEIFERMAN  
ENVIRONMENTAL PROTECTION AGENCY, EMISSION CONTROL TECHNOLOGY DIV., ANN ARBOR, MICH. 48105  
Rept. No. PB-270 692; EVAP-76-5; 1976; 14P 4REFS  
TECHNICAL SUPPORT REPT. FOR REGULATORY ACTION.  
Availability: NTIS

HS-022 837

## **DRIVER-VEHICLE BEHAVIOUR IN RESTRICTED-PATH TURNS**

AN EXPERIMENT WAS CONDUCTED IN WHICH DRIVERS NEGOTIATED A TEST COURSE CONTAINING 13 LOW-SPEED CURVES WITH WELL DEFINED LATERAL BOUNDARIES (RESTRICTED-PATH TURNS), BUT WERE FREE TO SELECT THEIR SPEED OF TRAVEL, IN ORDER TO SEE WHETHER THERE WAS ANY SIMILARITY BETWEEN THE DRIVER VEHICLE

BEHAVIOR IN THIS SITUATION, AND THAT EXHIBITED WHEN THE VEHICLE SPEED WAS DEFINED BY THE EXPERIMENTER BUT THERE WERE NO LATERAL CONSTRAINTS (FREE-PATH TURNS). AN EARLIER STUDY SHOWED THAT WHEN FREE TO CHOOSE THEIR OWN CURVED PATHS WITHOUT LATERAL CONSTRAINTS, DRIVERS DEVELOPED PATHS WHICH COULD BE CHARACTERIZED BY A "PREFERRED YAW RATE" WHICH WAS INDEPENDENT OF THE FORWARD SPEED OF THE VEHICLE, BUT INCREASED LOGARITHMICALLY WITH THE PRESCRIBED DEVIATION ANGLE OF THE TURN. IT WAS OBSERVED THAT THE RESULTS OF THESE FREE-PATH TURN EXPERIMENTS MAY HAVE PARTICULAR RELEVANCE TO THE DESIGN OF LOW-SPEED CURVES FOR INTERSECTIONS AND INTERCHANGES. FOR THE EXPERIMENT DESCRIBED, NO EVIDENCE WAS FOUND THAT THE PREFERRED YAW RATE BEHAVIOR IS RELEVANT TO RESTRICTED-PATH DRIVING. THE RESULTS INDICATE THAT THE MAXIMUM LATERAL ACCELERATION DEVELOPED WAS THE MAJOR DETERMINANT OF SPEED SELECTION ON A GIVEN RADIUS CURVE, THE LEVEL ADOPTED DECREASING WITH INCREASED CURVE RADIUS. THE DEVIATIONS OF THE VEHICLE PATHS FROM THE SET-OUT CURVES WERE EXAMINED IN DETAIL. THE EFFECT OF EXPERIMENTAL INSTRUCTIONS DESIGNED TO ELICIT "NORMAL" AND "STRESSED" DRIVING STRATEGIES WAS ALSO INVESTIGATED. THE DATA OBTAINED APPEAR TO PROVIDE THE FIRST COMPREHENSIVE COLLECTION OF DETAILED INFORMATION ON DRIVER/VEHICLE BEHAVIOR OVER A RANGE OF CURVE GEOMETRIES.

by M. C. GOOD; P. N. JOUBERT

Publ: ERGONOMICS V20 N3 P217-48 (MAY 1977) 1977; 30REFS

SPONSORED BY AUSTRALIAN RD. RES. BOARD. INCLUDES GERMAN SUMMARY.  
Availability: SEE PUBLICATION

HS-022 838

## **HOW FEASIBLE IS SONIC CARBURETION?**

THE DEVELOPMENT OF A SONIC CARBURETOR BY FORD MOTOR CO. STARTED WITH A VARIABLE-AREA CARBURETOR PATENTED BY DRESSER INDUSTRIES, AND RESULTED IN ONE FEASIBLE FOR PRODUCTION. THE SONIC APPROACH OFFERS THE FOLLOWING TWO PRINCIPAL BENEFITS: AN AIR FLOW DEPENDING ONLY ON THROAT GEOMETRY, UPSTREAM PRESSURE, AND TEMPERATURE; AND SIGNIFICANTLY IMPROVED AIR/FUEL DISTRIBUTION THROUGH A COLD INTAKE MANIFOLD. FORD HAS NO IMMEDIATE PLANS FOR PRODUCTION USE OF THIS SONIC CARBURETOR, BUT ITS COMPATIBILITY WITH CLOSED-LOOP CONTROL, FOR EXAMPLE, IS EVIDENT. THE SONIC NOZZLE'S "CRITICAL FLOW" NATURE WOULD BE A DEFINITE ASSET IN SUCH AN APPLICATION. CRITICAL FLOW IS ACHIEVED WHEN FLUID VELOCITY AT THE NOZZLE REACHES THE LOCAL SPEED OF SOUND IN THE FLUID. THIS "CHOKED" CONDITION CAN BE PREDICTED IN TERMS OF A CRITICAL RATIO OF STATIC PRESSURE AT THE THROAT TO TOTAL UPSTREAM PRESSURE. ANY CHANGES IN PRESSURE DOWNSTREAM HAVE NO EFFECT ON MASS FLOW THROUGH THE DEVICE.

ALSO, THE SONIC CARBURETOR'S COLD-START BENEFITS MIGHT MAKE IT FEASIBLE FOR SELECTIVE ADOPTION IN RESPONSE TO FTP'S (FEDERAL TEST PROCEDURE) 505-SEC FIRST BAG EMISSIONS TEST.

Publ: AUTOMOTIVE ENGINEERING V86 N4 P42-5 (APR 1978)

1978; IREF

BASED ON SAE-780078 "THE DESIGN AND DEVELOPMENT OF THE UPPER-PIVOTED SONIC CARBURETOR," BY CHARLES F. AQUINO, PRESENTED AT SAE CONGRESS, DETROIT, 27 FEB-3 MAR 1978.

Availability: SEE PUBLICATION

HS-022 839

### **MCA-JET SWIRLS MIXTURE FOR IMPROVED COMBUSTION**

THE DEVELOPMENT BY MITSUBISHI MOTORS CORPORATION OF A NEW MEANS FOR PROMOTING COMBUSTION TURBULENCE, THE MCA-JET, THAT IMPROVES LOW-SPEED, LIGHT-LOAD OPERATING MODES TYPICAL OF URBAN DRIVING IS DESCRIBED. THE MCA-JET ENGINE INCORPORATES EXTRA VALVES THAT INDUCT AIR INTO COMBUSTION CHAMBERS TO GENERATE CAREFULLY CONTROLLED TURBULENCE. FLAME PROPAGATION IS PROMOTED BY THIS INDUCED SWIRL THAT PERSISTS THROUGH BOTH COMPRESSION AND EXPANSION. MCA-JET BENEFITS INCLUDE A SUBSTANTIAL EXTENSION OF THE LEAN MIXTURE LIMIT, MORE STABLE COMBUSTION OF EGR (EXHAUST GAS RECIRCULATION)-DEADENED MIXTURES, AND SIGNIFICANTLY IMPROVED FUEL ECONOMY. THE MCA-JET SYSTEM IS STANDARD IN MITSUBISHI'S ENGINE FAMILY POWERING THE PLYMOUTH ARROW AND SAPPORO, AND DODGE CELESTE, CHALLENGER, AND COLT. THESE CARS, ALL IN THE ENVIRONMENTAL PROTECTION AGENCY'S (EPA) MINICOMPACT CLASS, HAVE COMBINED FUEL ECONOMY FIGURES IN THE 30-38 MPG RANGE.

Publ: AUTOMOTIVE ENGINEERING V86 N4 P46-8 (APR 1978)

1978

BASED ON SAE-780007 "DEVELOPMENT OF A NEW COMBUSTION SYSTEM (MCA-JET) IN GASOLINE ENGINE," BY H. NAKAMURA, T. OHINOUE, K. HORI, Y. KIYOTA, T. NAKAGAMI, K. AKISHINO, AND Y. TSUKAMOTO, PRESENTED AT SAE CONGRESS, DETROIT, 27 FEB-3 MAR 1978.

Availability: SEE PUBLICATION

HS-022 840

### **PNEUMATIC LEVELER HAS ELECTRONIC CONTROL [AUTOMOBILE LEVELING SYSTEM]**

AN AUTOMOBILE LEVELING SYSTEM DEVELOPED BY GENERAL MOTORS' DELCO PRODUCTS DIV. WHICH USES DRY AIR AS ITS WORKING FLUID IS DESCRIBED. AS DESIGNERS STRIVE TO MAINTAIN THE RIDE QUALITY OF SMALLER CARS, USE OF LOWER-RATE SUSPENSION SPRINGS INCREASES THE NEED FOR VEHICLE ATTITUDE CONTROL. SUCH

LEVELING SYSTEMS HAVE GENERALLY RELIED ON VACUUM-OPERATED COMPRESSORS TO PRESSURIZE AIR-ADJUSTABLE SHOCK ABSORBERS. WITH THE FUTURE REQUIREMENTS FOR EMISSION CONTROL AND FUEL ECONOMY, AND SPECIFICALLY WITH THE INCREASING USE OF DIESEL ENGINES, ENGINE VACUUM IS BECOMING UNAVAILABLE FOR THESE SYSTEMS. AN ELECTRONIC-CONTROLLED LEVELING SYSTEM USING DRY AIR AS ITS PRESSURE MEDIUM THUS BECOMES DESIRABLE FOR THESE NEWER VEHICLES AND IS BEING FACTORY-INSTALLED ON SOME 1978 GENERAL MOTORS CARS AND HAS BEEN APPLIED EXPERIMENTALLY TO LIGHT TRUCKS AND RECREATIONAL VEHICLES. THIS LEVELING DEVICE AUTOMATICALLY RAISES AND LOWERS THE REAR OF THE CAR BODY TO KEEP THE VEHICLE LEVEL AS IT IS LOADED AND UNLOADED. IT CONSISTS OF THE FOLLOWING THREE COMPONENTS: ELECTRIC COMPRESSOR AND AIR DRYER ASSEMBLY, ELECTRONIC HEIGHT SENSOR, AND AIR-ADJUSTABLE SPRINGS (NORMALLY AIR SHOCKS).

Publ: AUTOMOTIVE ENGINEERING V86 N4 P50-3 (APR 1978)

1978

BASED ON SAE-780051 "A DRY AIR, ELECTRONIC-CONTROLLED LEVELING SYSTEM FOR PASSENGER CARS AND LIGHT TRUCKS," BY JERRY W. BURNS, PRESENTED AT SAE CONGRESS, DETROIT, 27 FEB-3 MAR 1978.

Availability: SEE PUBLICATION

HS-022 841

### **TELEMETRY AIDS ROTARY ENGINE STUDY**

GENERAL MOTORS RES. LABS.' INVESTIGATION OF THE OPERATION OF THE ROTARY ENGINE VIA A NOVEL TELEMETRY TRANSMISSION SYSTEM IS DESCRIBED. TELEMETRIC PROCEDURES WERE APPLIED FOR MEASURING THE APEX SEAL TEMPERATURE, GAS PRESSURE, COMBUSTION PRESSURE, AND OTHER OPERATING PARAMETERS ESSENTIAL TO FURTHER DEVELOPMENT OF THE ROTARY COMBUSTION ENGINE. THIS SHORT-RANGE WIRELESS LINK JOINED THE TRANSDUCERS ON THE MOVING ROTOR WITH THE STATIONARY ENGINE HOUSING. LIMITS WERE IMPOSED ON THE DESIGN AND CONSTRUCTION OF CERTAIN MEASUREMENT SYSTEM COMPONENTS TO CONFORM TO THE DIFFICULTY OF THE TASK. IT WAS SHOWN THAT SHORT-RANGE RADIO TELEMETRY CAN BE A CONVENIENT AND SIMPLE METHOD OF MAKING ACCURATE MEASUREMENTS ON A MOVING COMPONENT. THE ABILITY OF A SMALL ENCAPSULATED TRANSMITTER TO FUNCTION DESPITE VIBRATION AT ELEVATED TEMPERATURES SUGGESTS MANY POTENTIAL APPLICATIONS WHERE OTHER TECHNIQUES WOULD BE DIFFICULT OR IMPOSSIBLE TO USE.

Publ: AUTOMOTIVE ENGINEERING V86 N1 P44-8 (JAN 1978)

1978

BASED ON SAE-770877 "TELEMETRY APPLICATIONS IN THE ROTARY COMBUSTION ENGINES," BY PHILIP M. LEUCHT AND DONALD J. MANDLEY, PRESENTED AT PASSENGER CAR MEETING, DETROIT, 26-29 SEP 1977.

Availability: SEE PUBLICATION

HS-022 842

**MANGANESE FUEL ADDITIVE CAN CAUSE CATALYST PROBLEMS**

SEVERAL INVESTIGATIONS OF THE EFFECT OF THE MANGANESE FUEL ADDITIVE MMT (METHYLCYCLOPENTADIENYL MANGANESE TRICARBONYL) ON MONOLITHIC CATALYTIC CONVERTERS ARE REPORTED. MOST OF THE CARS MANUFACTURED IN THE U.S. SINCE 1975 REQUIRE UNLEADED GASOLINE FOR SATISFACTORY OPERATION OF THE CATALYTIC CONVERTERS USED TO CONTROL EXHAUST EMISSIONS. AS MORE OF THE OLD FLEET IS REPLACED, THIS DEMAND MUST INCREASE. TO SATISFY THE NEED AND PROVIDE THE DESIRED OCTANE QUALITY, SOME PETROLEUM REFINERS HAVE BEGUN USING THE ANTIKNOCK ADDITIVE MMT. RECENT STUDIES HAVE INDICATED THAT MMT IS COMPATIBLE WITH ENGINES AND EMISSION CONTROL SYSTEMS IF USED WITHIN THE RECOMMENDED CONCENTRATION RANGE (LESS THAN OR EQUAL TO 0.033 G MN (MANGANESE)/L), THOUGH SOME PROBLEMS OCCURRED WITH MONOLITHIC CATALYSTS AND SPARK PLUGS IN SEVERE SERVICE. UNDER CERTAIN DRIVING CONDITIONS ITS USE MAY PLUG CONVERTERS AND INCREASE HC (HYDROCARBON) EMISSIONS, EITHER OF WHICH COULD CAUSE FUEL ECONOMY PENALTIES. THE ENERGY BENEFITS OF USING MMT TO INCREASE ANTIKNOCK QUALITY AND REFINERY YIELD HAVE BEEN ESTIMATED TO BE ABOUT 1% SAVINGS IN TERMS OF TOTAL CRUDE OIL USAGE. ADDITIONAL WORK IS NEEDED TO DETERMINE WHETHER CATALYST PLUGGING WOULD BE A SERIOUS FIELD PROBLEM AND WHETHER HC INCREASES THREATEN TO NEGATE EMISSION CONTROL GAINS MADE TO DATE.

Publ: AUTOMOTIVE ENGINEERING V86 N1 P58-64 (JAN 1978)

1978  
BASED ON SAE-770658 "CATALYST PLUGGING IN THRUWAY POLICE VEHICLES," BY GREGORY P. WOTZAK, NICHOLAS P. KOLAK, RICHARD E. GIBBS, AND ROGER J. CHENG, AND SAE-770655 "MANGANESE FUEL ADDITIVE (MMT) CAN CAUSE VEHICLE PROBLEMS," BY JACK D. BENSON, PRESENTED AT FUELS AND LUBRICANTS MEETING, TULSA, 7-9 JUN 1977.

Availability: SEE PUBLICATION

HS-022 843

**HIGHWAY NOISE MEASUREMENTS FOR VERIFICATION OF PREDICTION MODELS. FINAL REPORT**

DATA FROM A HIGHWAY TRAFFIC NOISE MEASUREMENT PROGRAM CONDUCTED IN THE STATES OF NORTH CAROLINA, FLORIDA, WASHINGTON, AND COLORADO ARE INTENDED TO EXPAND THE EXISTING HIGHWAY TRAFFIC NOISE INFORMATION BASE TO VALIDATE AND MODIFY, IF NECESSARY, HIGHWAY NOISE PREDICTION MODELS CURRENTLY USED BY VARIOUS STATE HIGHWAY DEPARTMENTS, PLANNING GROUPS, AND THE FEDERAL GOVERNMENT; AND TO PROVIDE EMPIRICAL DATA NECESSA-

RY TO CORRECT ANY PREDICTION INACCURACIES IN THESE EXISTING METHODS. THROUGHOUT THE FOUR STATES, 111 HOURS OF TRAFFIC NOISE WERE RECORDED, AS WELL AS INDIVIDUAL PASS-BY NOISE DATA FROM 2580 HEAVY TRUCKS AND 598 MEDIUM TRUCKS. THE FOLLOWING RESULTS ARE TABULATED SEPARATELY FOR EACH STATE: STATISTICAL NOISE INDEXES; OCTAVE-BAND FREQUENCY SPECTRA FOR INDIVIDUAL TRUCK PASS-BY NOISE; TRAFFIC COUNT AND AVERAGE SPEED BY LANE; INDIVIDUAL TRUCK PASS-BY DATA INCLUDING TRUCK TYPE, WEIGHT, AND SPEED; AND METEOROLOGICAL DATA. ALSO INCLUDED ARE TOPOGRAPHICAL PLOTS AND PHOTOGRAPHS OF THE MEASURING SITES. THE STATISTICAL NOISE DATA (IN DBA) PRODUCED CONSIST OF THE FOLLOWING FOR EACH OF FIVE TEN-MINUTE PERIODS OF A 50-MINUTE PERIOD AND FOR THE COMPOSITE 50-MINUTE PERIOD: ARITHMETIC AVERAGE LEVEL, STANDARD DEVIATION, ENERGY MEAN LEVEL, NOISE POLLUTION LEVEL, MAXIMUM LEVEL MEASURED, RANGE OF LEVELS MEASURED, LEVEL EXCEEDED 1% OF TIME, LEVEL EXCEEDED 10% OF TIME, LEVEL EXCEEDED 50% OF TIME, LEVEL EXCEEDED 90% OF TIME, AND LEVEL EXCEEDED 99% OF TIME. THE RESULTS WILL BE USED TO EVALUATE THE FOLLOWING THREE PREDICTION MODELS: TSC (TRANSPORTATION SYSTEMS CENTER) MODEL (TSC-MOD-02), VERSION 10 OF THE MICHIGAN NCHRP 117/144 MODEL, AND THE BOLT BERANEK AND NEWMAN REVISED DESIGN GUIDE (RDG) DEVELOPED UNDER NCHRP STUDY 3-7.

by EDWARD J. RICKLEY; DAVID W. FORD; ROBERT W. QUINN

TRANSPORTATION SYSTEMS CENTER, KENDALL SQUARE, CAMBRIDGE, MASS. 02142

Rept. No. DOT-TSC-OST-78-2; DOT-TSC-FHWA-78-1; 1978; 736P

REPT. FOR JAN 1975-APR 1976.

Availability: NTIS

HS-022 845

**TIRE ROLLING LOSSES AND FUEL ECONOMY--AN R AND D PLANNING WORKSHOP**

NINETEEN PAPERS AND ACCOMPANYING DISCUSSIONS, A PANEL DISCUSSION, AND A BIBLIOGRAPHY AND LIST OF PARTICIPANTS ARE INCLUDED IN THE VOLUME OF WORKSHOP PROCEEDINGS. PAPERS ON TIRE DESIGN AND CONSTRUCTION INCLUDED STUDIES ON THE POWER CONSUMPTION OF TIRES RELATED TO THEIR USE AND A COMPARISON OF RADIAL AND NONRADIAL TIRE CONSTRUCTION WITH RESPECT TO ROLLING RESISTANCE AND VEHICLE FUEL ECONOMY. PAPERS ON TESTING METHODS CONCERNED THE DEFINITION OF TIRE ROLLING LOSS, IMPROVEMENT OF STEADY-STATE TEST METHODS, VARIATIONS IN TIRE ROLLING RESISTANCE, AND LABORATORY MEASUREMENTS OF SAME. PAPERS ON ANALYTICAL METHODS AND MODELS INCLUDED DISCUSSIONS OF TIRE ROLLING RESISTANCE VIA VISCOELASTIC COMPONENT ANALYSIS, NUMERICAL SIMULATION OF ROLLING TIRES, TIRE POWER LOSS CALCULATIONS, TIRE THERMOGRAPHY AND ROLLING RESISTANCE, AND THE GEOMETRIC EFFECTS ON THE ROLLING RESISTANCE

OF PNEUMATIC TIRES. TOPICS CONSIDERED IN THE SECTION ON ROAD AND VEHICLE EFFECTS INCLUDED THE FOLLOWING: PAVEMENT AND TIRE ROLLING RESISTANCE COEFFICIENTS FOR VEHICLE ENERGY PREDICTION, DETERMINATION OF EFFECTIVE ROLLING RESISTANCE BY COASTDOWN EXPERIMENTS, INFLUENCE OF ROAD SURFACE TEXTURE ON TIRE ROLLING RESISTANCE, WHEEL/VEHICLE ENERGY LOSSES THROUGH ROAD CONTACT, AND ELEMENTARY TRANSFORMATION OF TIRE MU-SLIP AND THE SOIL SHEAR STRESS/STRAIN TEST CURVES. TIRE-MATERIALS PAPERS DEALT WITH THE EFFECT OF TREAD POLYMER VARIATIONS AND OF PASSENGER TIRE REINFORCING MATERIALS ON RADIAL TIRE ROLLING RESISTANCE.

SOCIETY OF AUTOMOTIVE ENGINEERS, INC., 400 COMMONWEALTH AVE., WARRENDALE, PA. 15096  
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HS-022 846

#### **POWER CONSUMPTION OF TIRES RELATED TO HOW THEY ARE USED**

THE FUEL CONSUMPTION OF A MOTOR VEHICLE AS RELATED TO THE MANNER IN WHICH ITS TIRES ARE USED, AND THUS THEIR ROLLING RESISTANCE, IS DISCUSSED. MOTOR VEHICLES CONSUME MORE THAN 25% OF THE NATION'S FUEL. TIRE ROLLING RESISTANCE ACCOUNTS FOR ABOUT 20% OF VEHICLE FUEL CONSUMPTION, OR ROUGHLY 5% OF THE FUEL CONSUMED IN THE U.S. FUEL CONSUMPTION IS ROUGHLY RELATED TO THE TIRE'S ROLLING RESISTANCE IN A 5:1 RATIO. A 5% REDUCTION IN ROLLING RESISTANCE GIVES A 1% FUEL SAVINGS. A TIRE'S ROLLING RESISTANCE IS A DIRECT FUNCTION OF HOW IT IS OPERATED. ROLLING RESISTANCE IS APPROXIMATELY PROPORTIONAL TO THE LOAD IT CARRIES AND TO THE INVERSE OF INFLATION PRESSURE TO THE 0.5 POWER. ROLLING RESISTANCE IS RELATIVELY INDEPENDENT OF THE SPEED IN THE 25-60 MPH RANGE. THERE ARE OTHER IMPORTANT OPERATING CONDITIONS SUCH AS ENVIRONMENTAL CONDITIONS (E.G. TEMPERATURE OF THE ROAD), TRIP LENGTH, LENGTH OF TIME THE VEHICLE HAD BEEN STANDING BEFORE THE TRIP, ROAD TYPE AND CONDITION, AND OCCURRENCES DURING THE TRIP (E.G. MODERATE TO SEVERE ACCELERATION). THE FOLLOWING FOUR PRINCIPAL WAYS TO REDUCE THE ROLLING RESISTANCE OF A TIRE ARE DISCUSSED: REDUCE THE TIRE DEFLECTION BY INCREASING ITS AIR PRESSURE OR REDUCING THE LOAD, CHANGE THE TIRE STRUCTURE TO REDUCE THE DISTORTION OF THE RUBBER AND CORDS FOR A GIVEN DEFLECTION, USE A RUBBER WHICH HAS LOWER HYSTERETIC LOSSES, AND GO AT A SUSTAINED SPEED ON A SMOOTH AND STRAIGHT DRY ROAD. THE FOLLOWING AREAS FOR FURTHER INVESTIGATIONS ARE RECOMMENDED: EFFECT OF ACTUAL DRIVING CONDITION ON ROLLING RESISTANCE, NONSUSTAINED DRIVING

AND COLD WEATHER; STANDARDIZATION OF ROLLING RESISTANCE MEASUREMENTS; AND IMPROVING THE MAINTENANCE OF AIR PRESSURE.

by W. K. KLAMP  
MCCREARY TIRE AND RUBBER CO.  
Publ: HS-022 845 (SAE-P-74), "TIRE ROLLING LOSSES AND FUEL ECONOMY--AN R AND D PLANNING WORKSHOP," WARRENDALE, PA., 1977 P5-11  
1977  
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HS-022 847

#### **A COMPARISON OF RADIAL AND NON-RADIAL TIRE CONSTRUCTION WITH RESPECT TO ROLLING RESISTANCE AND VEHICLE FUEL ECONOMY**

THE RESULTS OF LABORATORY AND ROAD TESTS RUN TO DETERMINE THE DIFFERENCE BETWEEN RADIAL AND NONRADIAL PASSENGER CAR AND TRUCK TIRES WITH RESPECT TO ROLLING RESISTANCE AND FUEL ECONOMY ARE REPORTED. THE TIRES USED WERE NEW AND WERE OF THE TYPE NORMALLY PROVIDED AS ORIGINAL EQUIPMENT. RADIAL PASSENGER CAR TIRES WERE FOUND TO HAVE AN AVERAGE OF 21% LESS ROLLING RESISTANCE AND AN AVERAGE OF 10% IMPROVED FUEL ECONOMY AT A CONSTANT SPEED OF 50 MPH COMPARED TO BELTED BIAS TIRES OVER A WIDE RANGE OF SIZES. THE DATA CONFIRM THAT TIRE ROLLING RESISTANCE IS ESSENTIALLY INDEPENDENT OF SPEED BETWEEN 30 AND 70 MPH. THE ADVANTAGE OF RADIALS WILL BE SOMEWHAT LESS WHEN WORN TIRES ARE COMPARED SINCE ROLLING RESISTANCE OF NONRADIAL TIRES IS STRONGLY INFLUENCED BY TREAD DEPTH, WHILE THE EFFECT ON RADIALS IS LESS. ALSO, THE FUEL ECONOMY IMPROVEMENT OBTAINED BY A CONSUMER WHO USES RADIAL TIRES WILL DEPEND ON HOW MUCH OF HIS/HER DRIVING IS AT STEADY HIGHWAY SPEEDS. FURTHERMORE, THE CONSUMER CAN EASILY LOSE THE FUEL ECONOMY ADVANTAGE OF RADIAL TIRES IF HE/SHE ALLOWS TIRE AIR PRESSURES TO DROP SIGNIFICANTLY BELOW THOSE RECOMMENDED. WITH RESPECT TO FUEL ECONOMY TESTS OF TRUCKS, RADIAL TIRES EXHIBITED 6% IMPROVED FUEL ECONOMY COMPARED TO BIAS PLY TIRES WHEN TESTED UNDER OPEN HIGHWAY DRIVING CONDITIONS. LABORATORY TESTS FOR ROLLING RESISTANCE WERE NOT CONDUCTED FOR TRUCK TIRES.

by K. L. CAMPBELL  
FIRESTONE TIRE AND RUBBER CO.  
Publ: HS-022 845 (SAE-P-74), "TIRE ROLLING LOSSES AND FUEL ECONOMY--AN R AND D PLANNING WORKSHOP," WARRENDALE, PA., 1977 P13-9  
1977  
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## A NEW LOOK AT THE DEFINITION OF TIRE ROLLING LOSS

EQUATIONS FOR DEFINING TIRE ROLLING LOSS ARE DISCUSSED. THE PRESENT CONCEPT OF TIRE ROLLING LOSS STILL REFLECTS THE STATE OF THE ART OF THE LATE 18TH CENTURY (COULOMB), WHERE FORCES AND MOMENTS RATHER THAN ENERGY WERE OF CONCERN. IT IS SUGGESTED THAT COULOMB'S APPROACH BE REVISED AND THAT THE DEFINITION OF ROLLING LOSS BE BASED ON THE ENERGY BALANCE EQUATION. FUTURE RESEARCH IS NEEDED ON THE CONTRIBUTION OF SLP AND OF VARIOUS TIRE COMPONENTS TO ROLLING LOSS.

by D. J. SCHURING

FIRESTONE TIRE AND RUBBER CO.

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## WHAT'S NEEDED TO IMPROVE STEADY STATE TEST METHODS [TIRE ROLLING RESISTANCE]

TEST CONDITIONS UNDER WHICH POWER CONSUMPTION AND/OR TIRE ROLLING RESISTANCE ARE MEASURED ARE CRITICALLY ANALYZED. IT IS SHOWN THAT DISCREPANCIES ENCOUNTERED IN MEASURING POWER CONSUMPTION ARE NOT CAUSED BY THE INSTRUMENTATION AT THE TEST FACILITY, BUT RATHER BY A LACK OF FULL UNDERSTANDING OF CERTAIN TEST CONDITIONS. THE FOLLOWING THREE AREAS WHICH CAUSE CONSIDERABLE CONCERN WITH RESPECT TO THE ABILITY OF REPRODUCING ROLLING RESISTANCE RESULTS WHEN OBTAINED AT DIFFERENT TEST LOCATIONS ARE DISCUSSED: INTERACTION OF DRUM CURVATURE EFFECT AND ROLLING RESISTANCE FORCE, STEADY-STATE OR EQUILIBRIUM POINT DETERMINATION, AND TESTING TECHNIQUES. A METHOD WHICH IS UNDER DEVELOPMENT TO ENABLE POWER CONSUMPTION MEASUREMENTS TO BE MADE IN LESS THAN SEVEN MINUTES IS OUTLINED. THE FOLLOWING RECOMMENDATIONS ARE PRESENTED: CONTINUE THE STUDY OF ROLLING RESISTANCE DATA REDUCTION, CONDUCT AN IN-DEPTH STUDY TO INVESTIGATE ALL THE FACTORS WHICH INFLUENCE THE MEASUREMENT OF ROLLING RESISTANCE AND DETERMINE THEIR RELATIVE SENSITIVITY, AND CONDUCT A STUDY OF ROLLING RESISTANCE MEASUREMENT TECHNIQUES IN ORDER TO DEVELOP A STANDARD TECHNIQUE.

by ARIEL STIEBEL

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## VARIATIONS IN TIRE ROLLING RESISTANCE--A "REAL WORLD" INFORMATION NEED

AN ANALYSIS OF TIRE ROLLING RESISTANCE DATA OBTAINED IN A RECENT ENVIRONMENTAL PROTECTION AGENCY (EPA) ROAD LOAD PROJECT IS PRESENTED. ROLLING RESISTANCE MEASUREMENTS OF APPROXIMATELY 60 SETS OF PASSENGER CAR TIRES WERE CONDUCTED ON ONE OF THE EPA LIGHT-DUTY VEHICLE ELECTRIC DYNAMOMETERS. STATISTICALLY SIGNIFICANT VARIATIONS WERE OBSERVED BY TIRE TYPE, TIRE MANUFACTURER (WHICH INCLUDED GOODRICH, UNIROYAL, GENERAL, FIRESTONE, GOODYEAR, MICHELIN, CONTINENTAL, TOYO, SEMPERIT, AND BRIDGESTONE), AND TIRE SIZE. THE AVERAGE DECREASE IN TIRE ROLLING RESISTANCE FROM BIAS PLY TIRES TO RADIAL TIRES WAS ABOUT 24% (A DIFFERENCE OF ABOUT 2.3 LB/KLB). THE VARIATIONS AMONG TIRE ROLLING RESISTANCE COEFFICIENTS BY TIRE MANUFACTURER, WITHIN EACH TIRE TYPE, WERE GREATER THAN THIS DIFFERENCE BETWEEN THE MEANS OF THE TIRE TYPES. FOR EXAMPLE, WITHIN THE RADIAL TIRE CLASSIFICATION THE VARIATIONS AMONG MANUFACTURERS WERE ALMOST 4.0 LB(NT)/KLB(KNT). IN THE CASE OF BIAS TIRES THE OBSERVED DECREASE IN THE ROLLING RESISTANCE COEFFICIENTS FROM 13-INCH TO 15-INCH TIRE SIZES WAS AS GREAT AS THE DIFFERENCE BETWEEN THE MEANS OF THE ROLLING RESISTANCE COEFFICIENTS FOR RADIAL AND BIAS TIRES. FOR RADIAL TIRES, THE DECREASE IN ROLLING RESISTANCE COEFFICIENTS FROM 13-INCH TO 15-INCH TIRES WAS SOMEWHAT LESS, ABOUT 0.9 LB(NT)/KLB(KNT). BASED ON THE EPA CYCLES, THE USE OF AVERAGE RADIAL PLY TIRES VS. AVERAGE BIAS TIRES IMPROVES FUEL ECONOMY ABOUT 4%. IMPROVEMENTS OF A SIMILAR SIZE WOULD BE EXPECTED IN TRANSITIONS FROM AVERAGE TO LOW ROLLING RESISTANCE RADIAL TIRES. SOMEWHAT SMALLER IMPROVEMENTS MAY ALSO BE EXPECTED IF A GENERAL TRANSITION WERE MADE TO LARGER DIAMETER TIRES. THESE IMPROVEMENTS OF ABOUT 4% AND 2% IN THE FUEL ECONOMY OF A TYPICAL VEHICLE REPRESENT RESPECTIVE REDUCTIONS IN NATIONAL AVERAGE FUEL CONSUMPTION OF ABOUT 4 AND 2 BILLION GALLONS OF GASOLINE ANNUALLY.

by GLENN D. THOMPSON; MYRIAM TORRES

ENVIRONMENTAL PROTECTION AGENCY

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## LABORATORY MEASUREMENTS OF TIRE ROLLING RESISTANCE UNDER SIMULATED DRIVING CYCLES

RECOMMENDATIONS ARE MADE FOR RESEARCH AND DEVELOPMENT ACTIVITIES THAT WILL LEAD TO LABORATORY TIRE ROLLING RESISTANCE MEA-

SUREMENTS UNDER REALISTIC TIRE OPERATING CONDITIONS. SIMULATION OF A DRIVING CYCLE IS ADVOCATED TO AUGMENT THE CURRENTLY ACCEPTED PRACTICE OF CONDUCTING MEASUREMENTS UNDER EQUILIBRIUM CONDITIONS. ENERGY CONSUMED BY THE TIRE DURING A DRIVING CYCLE CAN THEN BE USED AS A CRITERION TO EVALUATE AND COMPARE TIRE SAMPLES WITH RESPECT TO THEIR ROLLING RESISTANCE CHARACTERISTICS. THE FOLLOWING ADVANTAGES OF SIMULATED DRIVING CYCLE TESTS FOR LABORATORY MEASUREMENT OF TIRE ROLLING RESISTANCE ARE POINTED OUT: A MORE REALISTIC SIMULATION THAN EQUILIBRIUM TESTS, INCLUSION OF THE EFFECTS OF TIRE WARM-UP IN THE MEASUREMENTS, EVALUATION OF TIRES IN TERMS OF CHANGING OPERATING CONDITIONS SIMILAR TO THOSE THAT ARE ENCOUNTERED IN DRIVING SITUATIONS, AND ABILITY FOR TESTS TO BE OF SHORT DURATION AND CONSEQUENTLY RELATIVELY INEXPENSIVE. THE FOLLOWING ITEMS ARE SUGGESTED FOR RESEARCH EFFORTS TO DEVELOP A TECHNIQUE TO MEASURE TIRE ROLLING RESISTANCE IN THE LABORATORY UNDER REALISTIC OPERATING CONDITIONS: ESTABLISHMENT OF TRENDS IN THE RESPONSE OF TIRES TO PROGRAMMED CYCLIC VARIATIONS OF PARAMETERS, PROCESSING, AND ANALYSIS OF MEASURED RESULTS FROM CYCLE TESTS IN ORDER TO ESTABLISH A BASIS FOR TIRE EVALUATION, PERFORMANCE OF A CORRELATION STUDY TO COMPARE THE EVALUATION OF TIRE ROLLING RESISTANCE AS DETERMINED BY CYCLE SIMULATION TESTING AND TESTING AT EQUILIBRIUM, CONSIDERATION OF LABORATORY TIRE TEST EQUIPMENT FOR ADEQUACY IN CONDUCTING ACCURATE ROLLING RESISTANCE TESTING, AND PERFORMANCE OF A STUDY IN WHICH THE EFFECTS OF TEMPERATURE ON ROLLING RESISTANCE FORCE WOULD BE QUANTIFIED.

by I. GUSAKOV  
CALSPAN CORP.  
Publ: HS-022 845 (SAE-P-74), "TIRE ROLLING LOSSES AND FUEL ECONOMY--AN R AND D PLANNING WORKSHOP," WARRENDALE, PA., 1977 P65-71  
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### THE TIRE ROLLING RESISTANCE VIA VISCOELASTIC ANALYSIS OF THE COMPONENTS

A METHOD IS DESCRIBED TO ESTABLISH THE RELATIONSHIP BETWEEN THE TIRE ROLLING RESISTANCE AND THE TOTAL HEAT LOSS FROM THE TIRE. THE HEAT LOSS IS DETERMINED FROM CROSS-SECTIONAL TEMPERATURE PROFILES IN THE TIRE WHICH ARE CALCULATED BY SOLVING THE ENERGY TRANSFER EQUATIONS CONTAINING THE HEAT GENERATION TERMS. THE DATA INPUT REQUIRED IN THIS SOLUTION COMPRISES THE FOLLOWING: TIRE CONSTRUCTION VARIABLES (E.G. TIRE GEOMETRY, NUMBER OF PLYS, PLY CONSTRUCTION, CORD CHARACTERISTICS AND BELT DESIGN); DYNAMIC VISCOELASTIC PROPERTIES OF COMPONENTS (CORD, RUBBER, ETC.) AS A FUNCTION OF STRAIN AMPLITUDE, FREQUENCY AND TEMPERA-

TURE; MATERIAL PROPERTIES APPEARING IN ENERGY TRANSFER EQUATIONS (E.G. DENSITY, HEAT CAPABILITY, AND THERMAL CONDUCTIVITY); HEAT TRANSFER COEFFICIENTS; AND FIVE TO SIX TIRE TEMPERATURES DURING ROLLING AT POSITIONS WHICH ENABLE THE DETERMINATION OF A COMPLETE TEMPERATURE PROFILE. ROLLING RESISTANCE OF SEVERAL TYPES OF TIRES WAS MEASURED, AND HEAT LOSS WAS ESTIMATED BY THE PROCEDURE DESCRIBED ABOVE. IN ADDITION, THE EFFECT OF TIRE TESTING CONDITIONS (I.E. SPEED AND LOAD ON TIRE) ON THESE TWO TIRE PERFORMANCE CHARACTERISTICS WAS INVESTIGATED. IN ALL CASES A GOOD CORRELATION WAS FOUND BETWEEN ROLLING RESISTANCE AND HEAT LOSS.

by D. C. PREVORSEK; Y. D. KWON; R. K. SHARMA  
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### NUMERICAL SIMULATION OF ROLLING TIRES

AN OVERVIEW IS PRESENTED OF THE BASIC REQUIREMENTS WHICH AN ANALYTICAL/NUMERICAL (FINITE-ELEMENT) SIMULATION OF THE POWER DISSIPATION-ROLLING RESISTANCE PROBLEM OF TIRES MUST SATISFY; AND IN CONJUNCTION WITH THIS OVERVIEW, A STEADY-STATE MODEL IS DEVELOPED. BASED ON THE MODEL DEVELOPED, SEVERAL NUMERICAL EXPERIMENTS ARE CONSIDERED (THE STANDING WAVE PROBLEM, AND ROLLING THERMAL CONTACT). BASED ON THE INITIAL SUCCESS OF SUCH WORK, SEVERAL AREAS OF FUTURE TIRE MODELING ARE PROPOSED. FROM THE EXPERIMENTAL POINT OF VIEW, FURTHER WORK IS NECESSARY TO ESTABLISH PHENOMENOLOGICAL MODELS OF THE CONTACT PATCH AND ITS CONCOMMITANT FRICTIONAL BEHAVIOR, AS WELL AS OF THE BILINEAR THERMOVISCOELASTIC BEHAVIOR OF THE VARIOUS CORD-RUBBER COMPOSITES EMPLOYED IN TIRE CONSTRUCTION. SUCH WORK SHOULD BE DONE CONCURRENTLY WITH THE DEVELOPMENT OF FINITE-ELEMENT MODELS WHICH CAN HANDLE BOTH THE CONTACT PATCH/RIM-TIRE INTERFACE AND BILINEAR MATERIAL BEHAVIOR. FURTHER WORK IS ALSO NECESSARY TO DEVELOP NUMERICAL ALGORITHMS WHICH CAN STREAMLINE THE ALGORITHMIC HANDLING OF BILINEAR THERMOVISCOELASTICITY. THE STEADY-STATE SOLUTION DEVELOPED IS AN EXAMPLE OF SUCH AN ALGORITHM.

by JOSEPH PADOVAN  
UNIVERSITY OF AKRON  
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1977; 15REFS  
INCLUDES DISCUSSION BY J. TIELKING.  
Availability: IN HS-022 845

HS-022 854

# **AN ANALYTICAL METHOD FOR TIRE POWER LOSS CALCULATIONS**

AN ANALYTICAL METHOD FOR CALCULATING THE INFLUENCE OF TIRE DESIGN PARAMETERS ON STEADY-STATE TIRE POWER LOSS IS PRESENTED. THE ANALYSIS IS BASED ON THE ASSUMPTIONS THAT TIRE STRUCTURAL RESPONSE IS LINEARLY VISCOELASTIC WITH RESPECT TO CONTACT LOADS, AND TIRE MATERIAL EXHIBITS A LOW LOSS TANGENT (LINEARITY WITH RESPECT TO INFLATION PRESSURE AND CENTRIFUGAL FORCES NOT ASSUMED). THESE ASSUMPTIONS PERMIT VISCOELASTIC POWER LOSS TO BE CALCULATED FROM LOAD TRANSFER FUNCTIONS DERIVED FROM SOLUTIONS FOR THE ELASTIC RESPONSE OF THE TIRE. THE LOSS COMPONENTS OF THE MODULI OF BOTH RUBBER AND CORD ARE INCLUDED IN PREDICTING POWER LOSS. THE ANALYTICAL METHOD IS NOT TIED TO ANY PARTICULAR TIRE MODEL. POWER LOSS CALCULATIONS MADE WITH A CONTINUUM TIRE MODEL ARE PRESENTED IN ORDER TO ILLUSTRATE THE METHOD, AND THE UTILIZATION OF A FINITE-ELEMENT TIRE MODEL IS DISCUSSED.

by J. T. TIELKING; R. A. SCHAPERY  
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HS-022 855

# **APPLICATIONS OF TIRE THERMOGRAPHY TO ROLLING RESISTANCE**

A NONSTEADY-STATE, FINITE-DIFFERENCE THERMAL ANALYSIS PROCEDURE HAS BEEN DEVELOPED WHICH MAKES IT POSSIBLE TO CALCULATE INTERNAL TEMPERATURES, HEAT GENERATION RATES IN EACH PART OF A ROLLING TIRE, AND TOTAL POWER LOSS FROM INFRARED SURFACE TEMPERATURE MEASUREMENTS MADE ON THE TIRE. THE PROCEDURE CAN ALSO BE REVERSED TO CALCULATE INTERNAL TEMPERATURES, HEAT GENERATION RATES IN EACH PART OF THE TIRE AND NON-STEADY-STATE POWER LOSS FOR ANY COMBINATION AND SEQUENCE OF LOAD, SPEED, INFLATION PRESSURE, AMBIENT TEMPERATURES, AND TIME. IN ORDER TO DO THIS, IT IS FIRST NECESSARY TO RUN THE APPROPRIATE EXPERIMENTS TO DETERMINE HEAT GENERATION RATES AS FUNCTIONS OF THESE VARIABLES. THE CALCULATED HEAT GENERATION RATES FOR EACH PART OF THE TIRE IN EFFECT TELL HOW MUCH OF THE TOTAL ROLLING POWER LOSS IS GENERATED BY EACH PART OF THE TIRE.

by N. M. TRIVISONNO  
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# **GEOMETRIC EFFECTS ON THE ROLLING RESISTANCE OF PNEUMATIC TIRES**

THE QUESTION OF GEOMETRIC EFFECTS ON THE ROLLING RESISTANCE OF PNEUMATIC TIRES IS ANALYZED. DATA ON TRUCK TIRES WERE USED TO EVALUATE THE CONSTANT IN AN EXPRESSION FOR ROLLING LOSS, AND USING THAT VALUE, A SERIES OF PARAMETRIC STUDIES WAS CARRIED OUT ON THE INFLUENCE OF SECTION WIDTH, SECTION HEIGHT, INFLATION PRESSURE, AND TIRE SIZE ON THE ROLLING RESISTANCE EFFICIENCY OF THE TIRE, DEFINED AS THE RATIO OF LOAD CARRYING ABILITY TO THE DRAG GENERATED BY THE TIRE IN FREE ROLLING. NO ATTEMPT WAS MADE TO INCLUDE THE INFLUENCE OF TIRE BRAKING OR TORQUE. THESE ANALYTICAL STUDIES MAKE IT CLEAR THAT THERE ARE GEOMETRIC INFLUENCES ON THE ROLLING RESISTANCE OF A PNEUMATIC TIRE AND THAT SUCH INFLUENCES, WHILE ONLY ROUGHLY UNDERSTOOD AT THIS TIME, CAN CONTRIBUTE SIGNIFICANTLY TO THE REDUCTION OF FUEL CONSUMPTION BY PASSENGER CARS AND COMMERCIAL VEHICLES. IT IS RECOMMENDED THAT THE EFFECT OF TIRE GEOMETRY ON ROLLING RESISTANCE BE CLEARLY DEFINED BY FURTHER ANALYTICAL STUDIES SO THAT ITS IMPACT MAY BE TAKEN INTO ACCOUNT WHEN CONSIDERING POSSIBLE DIRECTIONS FOR FUTURE VEHICLE DESIGN.

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HS-022 857

# **PAVEMENT AND TIRE ROLLING RESISTANCE COEFFICIENTS FOR VEHICLE ENERGY PREDICTION**

TIRE ROLLING RESISTANCE COEFFICIENTS DERIVED FROM THE LITERATURE THAT HAVE BEEN USED BY THE AUTHORS IN MATH MODELING PROJECTS ARE SUMMARIZED, AND AN ANALYSIS OF THE INFLUENCES OF PAVEMENT TYPE ON THE ROLLING RESISTANCE USING AN EXPERIMENTAL TESTING METHOD IS PRESENTED. MANY INVESTIGATORS HAVE PUBLISHED WORK ON INVESTIGATIONS OF THE INDIVIDUAL TRACTIVE RESISTANCE FORCES ACTING ON A VEHICLE, BUT A COMPARISON OF THEIR RESULTS SHOWS RATHER WIDE VARIATIONS IN SOME PLACES. THE DEGREE OF VARIABILITY AMONG ROLLING RESISTANCE COEFFICIENTS MAY BE ACCOUNTED FOR BY ONE OF THE FOLLOWING ITEMS: TIRE PROPERTIES, ROAD SURFACE AND PAVEMENT TYPE, CHASSIS FRICTION OF THE VEHICLE, AND METHOD OF DETERMINATION AND COMPUTATION. IF MATH MODELING OF A VEHICLE IS TO BE A VIABLE TOOL FOR THE PREDICTION OF ENERGY UTILIZATION, THESE ITEMS SHOULD BE INVESTIGATED WITH THE AIM OF A MORE PRECISE CHARACTERIZATION OF "ROLLING RESISTANCE."

FURTHERMORE, TIRE AND ROAD MATERIALS AND VEHICLE MECHANICS HAVE CHANGED OVER THE YEARS AND SOME OF THE EQUATION COEFFICIENTS IN PRINT NEED TO BE EVALUATED IN THE LIGHT OF PRESENT PRACTICE. THE EXPERIMENTAL METHOD DESCRIBED IS PROPOSED AS AN ELEMENTARY TECHNIQUE FOR MEASURING ROLLING RESISTANCES OVER RELATIVELY SHORT DISTANCES. DATA AND RESULTS ARE PRESENTED WHICH WERE OBTAINED WHEN THIS METHOD WAS EMPLOYED TO MEASURE THE INTERACTION BETWEEN TWO DIFFERENT PAVEMENT TYPES (PORTLAND CEMENT CONCRETE AND ASPHALT CONCRETE) AND VARIOUS AUTOMOBILE MODELS. RECOMMENDATIONS MADE FOR APPLICATIONS OF THIS TECHNIQUE INCLUDE DETERMINING THE ECONOMICS AND ENERGY CONSEQUENCES OF VARIOUS TYPES OF ROADWAY PAVEMENTS AND ROADWAY STRUCTURE, AND HIGHWAY MAINTENANCE PROGRAMS.

by R. E. PHELPS; J. G. MINGLE  
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#### **DETERMINATION OF EFFECTIVE ROLLING RESISTANCE BY COASTDOWN EXPERIMENTS ON SMOOTH AND ROUGH ROADS**

THEORETICAL AND EXPERIMENTAL STUDIES ON THE DETERMINATION OF EFFECTIVE TIRE ROLLING RESISTANCE UNDER COASTDOWN CONDITIONS ON SMOOTH AND ROUGH ROADS ARE REPORTED. CAREFULLY CONDUCTED EXPERIMENTS ON SMOOTH LEVEL ROADS, TOGETHER WITH LABORATORY TESTS OF THE TIRES USED IN THESE RUNS, PROVIDE INFORMATION ON THE AERODYNAMIC DRAG COMPONENT AND SERVE AS THE BASIS FOR THE EVALUATION OF RUNS ON ROUGH ROADS. THE MATHEMATICAL CONCEPT OF PARAMETER IDENTIFICATION BY OPTIMIZATION BECOMES FEASIBLE THROUGH THE EFFICIENCY OF LARGE COMPUTER SYSTEMS CAPABLE OF PROCESSING LARGE SAMPLES IN MULTIPLE ITERATIVE PROGRAMS. COMPUTER PROGRAMS HAVE BEEN DEVELOPED AND ARE OPERATIONAL WHICH CAN BOTH PROCESS AND EVALUATE EXPERIMENTAL COASTDOWN DATA AND GENERATE ACCURATE (AS WELL AS SUBSEQUENT RANDOMIZED) INPUT FOR SENSITIVITY STUDIES. DATA ACQUISITION, STORAGE, AND PROCESSING SYSTEMS WHICH HAVE BEEN DEVELOPED AND TESTED AND WHICH PROVIDE COMPUTER INPUT OF ACCEPTABLE ACCURACY ARE DESCRIBED. AS A RESULT OF THESE DEVELOPMENTS, ENERGY LOSSES OF VEHICLES DUE TO ROAD ROUGHNESS CAN BE EVALUATED AS A FUNCTION OF TIRE PRESSURE. THIS IS ILLUSTRATED BY PRELIMINARY, YET APPARENTLY CONCLUSIVE, DATA OBTAINED WITH

AN INSTRUMENTED TEST VEHICLE IN REPEATED RUNS OVER A WIDE RANGE OF TIRE PRESSURES.

by H. H. KORST; M. A. FUNFSINN  
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN,  
DEPT. OF MECHANICAL AND INDUSTRIAL  
ENGINEERING  
DOT-OS-6012

Publ: HS-022 845 (SAE-P-74), "TIRE ROLLING LOSSES AND FUEL ECONOMY--AN R AND D PLANNING WORKSHOP," WARRENDALE, PA., 1977 P133-41  
1977; 7REFS  
Availability: IN HS-022 845

HS-022 859

#### **THE INFLUENCE OF ROAD SURFACE TEXTURE ON TIRE ROLLING RESISTANCE**

IN AN EFFORT TO DEVELOP REALISTIC TIRE TEST AND TO MORE CLEARLY UNDERSTAND TIRE ROLLING RESISTANCE CHARACTERISTICS, A LIMITED STUDY WAS UNDERTAKEN TO ASSESS THE EFFECTS OF ROAD SURFACE TEXTURE. DATA OBTAINED FROM LABORATORY TIRE DYNAMOMETER TESTS (USING A SMOOTH STEEL SURFACE AND A 3 M SAFETY-WALK SURFACE (80-GRIT SANDPAPER TYPE TEXTURE)) AND OUTDOOR TESTS CONDUCTED ON VARIOUS PAVED, PUBLIC-TYPE ROADS (POLISHED CONCRETE, NEW CONCRETE, ROLLED ASPHALT MIXED AGGREGATE-ROUNDED, ROLLED ASPHALT MIXED AGGREGATE, AND ASPHALT WITH COARSE SEAL COAT) INDICATE THAT TIRE ROLLING RESISTANCE LOSSES INCREASE AS ROAD SURFACE TEXTURE INCREASES. ALTHOUGH SOME TIRES WERE MORE SENSITIVE THAN OTHERS, AVERAGE ROLLING RESISTANCE DIFFERENCES OF 5% WERE SEEN BETWEEN THE SMOOTH STEEL AND THE 3-M SAFETY-WALK IN THE LAB, WHILE THE OUTDOOR DATA INDICATE ROLLING RESISTANCE DIFFERENCES OF 30% OR MORE ON THE HARD-SURFACED PUBLIC ROADS. DIFFERENCES OF 8% WERE DETECTED ON PRIMARY-TYPE HIGHWAYS ALONE. ROLLING RESISTANCE DIFFERENCES OF THIS MAGNITUDE ARE QUITE SIGNIFICANT, AND AN IMPORTANT POINT IS THAT ANY IMPROVEMENTS WHICH CAN BE MADE THROUGH SURFACE DESIGN WOULD APPLY TO ALL TIRES IN THE MARKETPLACE, AND NOT ONLY THOSE FUTURE TIRES DEVELOPED WITH ROLLING RESISTANCE AS A DESIGN PARAMETER. HOWEVER, IT HAS BEEN SHOWN THAT SURFACE TEXTURE CAN ALSO INFLUENCE TIRE NOISE AND TRACTION PERFORMANCE. THEREFORE, ANY APPROACH MUST BE BASED ON AN OVERALL CONSIDERATION OF ALL THE RELATED TIRE PERFORMANCE AREAS.

by L. W. DERAAD  
GENERAL MOTORS CORP.

Publ: HS-022 845 (SAE-P-74), "TIRE ROLLING LOSSES AND FUEL ECONOMY--AN R AND D PLANNING WORKSHOP," WARRENDALE, PA., 1977 P143-9  
1977; 5REFS  
Availability: IN HS-022 845

HS-022 860

**WHEEL/VEHICLE ENERGY LOSSES THROUGH ROAD CONTACT**

THE ONLY SIGNIFICANT ENERGY WHICH A TIRE CAN WASTE IS SLIP ENERGY, DEFINED AS THE PRODUCT OF THE TOTAL HORIZONTAL FORCE ACTING AS THE INTERFACE AND THE TOTAL RELATIVE SLIP DISTANCE INDUCED BY THAT FORCE. THE ROLLING RESISTANCE OF A TIRE IS NOT NECESSARILY SIGNIFICANT IN FUEL SAVING. EXAMPLES ARE CITED WHICH POINT OUT THAT THE SYSTEM WHICH CAN REDUCE ENERGY WASTE, THEREBY INCREASING FUEL ECONOMY, IS MADE UP OF THE VEHICLE, THE TIRE, AND THE ROAD. EACH MILE THE TIRE SLIPS WASTEFULLY IS A MILE PAID FOR BUT NEVER RECEIVED. THE COST OF THAT MILE IS NOT ONLY IN THE FUEL WASTED BUT IN THE TIRE TREAD, THE ROAD, AND THE VEHICLE STRUCTURE AS WELL. A METHOD FOR ACCOUNTING FOR SLIP ENERGY DISPOSITION AT THE TIRE ROAD INTERFACE IS BASED ON ENERGY CONSERVATION PRINCIPLES WHICH DICTATE THAT THE VEHICLE/TIRE SLIP ENERGY DEMAND CAN BE QUANTIFIED FOR ANY BOUND SURFACE. THE ADDITIONAL SLIP ENERGY REQUIRED TO NEGOTIATE AN UNBOUND ROAD SURFACE IN THE SAME MANNER MUST RELATE TO ROAD PARTICULATE DISPLACEMENT IN THE CONTACT PATCH. ON CERTAIN UNBOUND ROAD SURFACES WHICH ARE INEFFICIENTLY ALIGNED AND MAINTAINED FOR VEHICLE TRAFFIC, THE TIRES ON THE VEHICLE WILL SLIDE SIGNIFICANT DISTANCES WITH A PROPORTIONAL WASTE OF FUEL, TIRES, VEHICLE, AND ROAD SURFACE. IN ORDER TO QUANTIFY THE SLIP ENERGY DISPOSITION, AN INSTRUMENT WHICH MEASURES THE TRIAXIAL FORCES AND THE TRIAXIAL VELOCITIES ACTING ON EACH WHEEL SIMULTANEOUSLY HAS BEEN DESIGNED AND IS CURRENTLY IN OPERATION AT THE NEVADA AUTOMOTIVE TEST CENTER.

by HENRY C. HODGES; HENRY C. HODGES, JR.  
NEVADA AUTOMOTIVE TEST CENTER  
Publ: HS-022 845 (SAE-P-74), "TIRE ROLLING LOSSES AND FUEL ECONOMY--AN R AND D PLANNING WORKSHOP," WARRENDALE, PA., 1977 P151-4  
1977; 3REFS  
Availability: IN HS-022 845

HS-022 861

**ELEMENTARY TRANSFORMATION OF TIRE MU-SLIP AND SOIL SHEAR STRESS/STRAIN TEST CURVES**

A NEW METHOD FOR FUNCTIONAL REPRESENTATION OF TIRE MU-SLIP AND SOIL SHEAR STRESS/STRAIN TEST CURVES IS PRESENTED; IT DOES NOT DISTORT THE CURVES' CHARACTERISTIC INITIAL SLOPES AND FINAL ASYMPTOTIC VALUES. THE TEST CURVES, AND THEIR DERIVATIVES, CAN BE FITTED TO ANY DESIRED ACCURACY BY INCREASING THE DEGREE OF THE POLYNOMIAL EXPRESSION THAT REPRESENTS THEM. CONSTANTS FOR CURVE FITTING ARE FOUND BY LINEAR EQUATIONS SUITABLE FOR LEAST SQUARES SOLUTION. IN ADDITION, A METHOD IS PRESENTED FOR MUL-

TIVARIATE TRANSFORMATION OF THE DERIVED CURVES THROUGH INTERPOLATION OF THEIR CONSTANTS. CURVES CORRESPONDING TO ANY DESIRED COMBINATION OF PARAMETERS, SPANNED BY A SET OF TEST CURVES, CAN BE GENERATED BY THESE TRANSFORMATIONS.

by LEONARD DELLA-MORETTA  
FOREST SERVICE, EQUIPMENT DEVEL. CENTER  
Publ: HS-022 845 (SAE-P-74), "TIRE ROLLING LOSSES AND FUEL ECONOMY--AN R AND D PLANNING WORKSHOP," WARRENDALE, PA., 1977 P155-8  
1977; 5REFS  
Availability: IN HS-022 845

HS-022 862

**THE EFFECT OF TREAD POLYMER VARIATIONS ON RADIAL TIRE ROLLING RESISTANCE**

STEEL-BELTED RADIAL PASSENGER CAR TIRES FEATURING VARIOUS TREAD POLYMERS WERE EVALUATED FOR ROLLING RESISTANCE CHARACTERISTICS. UNUSED TIRES WERE BUFFED AND RETREADED WITH THE FOLLOWING SEVEN DIFFERENT TREAD RUBBERS (AND RESPECTIVE TRADE NAMES): NATURAL RUBBER (HARTEX 20), HIGH CIS-POLYBUTADIENE (AMERIPOL CB220), SOLUTION STYRENE-BUTADIENE (OIL EXTENDED) (STEREON 750), EMULSION STYRENE-BUTADIENE (OIL EXTENDED) (S-249), POLYBUTADIENE (DIENE 55), POLYISOPRENE (AMERIPOL SN606), AND BUTYL (BUTYL 268). A DEFINITE INFLUENCE OF TREAD RUBBER TYPE ON THE ROLLING RESISTANCE WAS FOUND. IN ALL CASES, THE NATURAL RUBBER TREAD EXHIBITED THE LOWEST ROLLING LOSSES, WITH THE BUTYL TREAD HAVING THE HIGHEST AND THE OTHER POLYMERS BEING INTERMEDIATE. IF UNCONVENTIONAL RUBBERS ARE CONSIDERED (ALL EXCEPT BUTYL), THERE IS UP TO 12% DIFFERENCE IN ENERGY LOSS DUE TO CHANGES IN THE TYPE OF TREAD POLYMER FOR THE UNWORN TIRE CONDITION. IMPACT RESILIENCE TESTS CONDUCTED AT AVERAGE TIRE OPERATING TEMPERATURES SHOW BORDERLINE ACCEPTABILITY AS BEING USEFUL IN RANK ORDERING TIRES WITH DIFFERENT TREAD RUBBERS FOR ROLLING LOSS CHARACTERISTICS. EXCELLENT CORRELATION WAS ACHIEVED BETWEEN THE DYNAMIC DAMPING COEFFICIENT (OR LOSS MODULUS) OF THE TREAD RUBBER AS MEASURED BY COMPRESSION-FORCED VIBRATION TESTING AND TIRE ROLLING RESISTANCE FOR CERTAIN SPECIMEN TEST CONDITIONS.

by J. D. HUNT; J. D. WALTER; G. L. HALL  
FIRESTONE TIRE AND RUBBER CO., CENTRAL RES. LABS.  
Publ: HS-022 845 (SAE-P-74), "TIRE ROLLING LOSSES AND FUEL ECONOMY--AN R AND D PLANNING WORKSHOP," WARRENDALE, PA., 1977 P161-8  
1977; 14REFS  
Availability: IN HS-022 845

## EFFECT OF PASSENGER TIRE REINFORCING MATERIALS ON ROLLING RESISTANCE

THE EFFECT OF CORD REINFORCEMENTS IN THE CARCASSES AND BELTS OF PASSENGER CAR TIRES ON ROLLING RESISTANCE WAS EXPERIMENTALLY STUDIED. HR78-15 CUSTOM POLYSTEEL RADIALS WERE MODIFIED TO INCLUDE RAYON, NYLON, POLYESTER, FIBERGLASS, AND ARAMID CARCASSES. IN ADDITION, FIBERGLASS, ARAMID, AND TWO TYPES OF STEEL CORDS WERE USED IN THE BELTS. ROLLING RESISTANCE DATA WERE GENERATED WITH COASTDOWN AND CONSTANT-SPEED WHEEL METHODS. ALTHOUGH MANY OF THE REINFORCEMENTS DID NOT SHOW STATISTICALLY SIGNIFICANT DIFFERENCES AT 95% CONFIDENCE LEVEL, MAJOR REDUCTION IN ROLLING RESISTANCE WAS OBSERVED WITH CARCASSES AND BELTS CONSTRUCTED WITH ARAMID. ON THE OTHER HAND, RAYON CARCASSES WERE CHARACTERIZED BY HIGHER ROLLING RESISTANCE. A DISTINCTIVE INCREASING TREND IN ROLLING RESISTANCE WITH INCREASING CARCASS AND BELT WEIGHTS WAS SHOWN. IT IS RECOMMENDED THAT ADDITIONAL EFFORTS BE UNDERTAKEN TO FURTHER ESTABLISH THE ROLE OF TIRE REINFORCEMENTS IN PASSENGER CAR TIRE ROLLING RESISTANCE. EXPERIMENTAL CHARACTERIZATION OF STATIC AND DYNAMIC MATERIAL PROPERTIES OF CARCASS AND BELT COMPOSITES SHOULD BE PURSUED. THIS SHOULD ASSIST IN PROVIDING GREATER INSIGHT INTO THE MECHANISMS WHICH INFLUENCE REINFORCEMENT CONTRIBUTIONS TO ROLLING RESISTANCE. ADDITIONAL ROLLING RESISTANCE EVALUATIONS OF CARCASS AND BELT REINFORCEMENTS OF OTHER TIRE DESIGNS WITH THE AID OF WHEEL TESTS ARE ALSO RECOMMENDED.

by J. J. VORACHEK; R. J. DILL; R. J. MONTAG  
GOODYEAR TIRE AND RUBBER CO.  
Publ: HS-022 845 (SAE-P-74), "TIRE ROLLING LOSSES  
AND FUEL ECONOMY--AN R AND D PLANNING  
WORKSHOP," WARRENDALE, PA., 1977 P169-78  
1977; 5REFS  
Availability: IN HS-022 845

HS-022 864

## TWO-STROKE CYCLE DIESEL ENGINE FUEL ECONOMY IMPROVEMENT AND EMISSION REDUCTION

AN 8V-71TAE DIESEL ENGINE WAS DEVELOPED FROM THE BASIC 8V-71T ENGINE BY REMATCHING THE TURBOCHARGER-BLOWER SYSTEM, INCORPORATING INTAKE AIR CHARGE COOLING, AND OPTIMIZING THE INTAKE AND EXHAUST TIMING, THE NUMBER OF INTERIOR ORIFICES, AND THE FUEL INJECTION TIMING. INJECTION TIMING RETARD PRODUCES NONLINEAR OXIDES OF NITROGEN (NOX) TRADEOFFS WITH FUEL ECONOMY, BUT NOX ARE REDUCED LINEARLY WITH INJECTION TIMING. CARBON MONOXIDE AND SMOKE EMISSIONS ARE SIGNIFICANTLY BELOW THE STANDARDS. THE ENGINE HAS BEEN SUBJECTED TO THE FEDERAL AND CALIFORNIA EMISSION TESTS AND HAS DEMON-

STRATED THAT IT CAN ACHIEVE THE EMISSION STANDARDS WITH ACCEPTABLE EXHAUST SMOKE AND IMPROVED FUEL ECONOMY.

by J. F. PEARCE; R. J. HAMES; D. F. MERRION  
GENERAL MOTORS CORP., DETROIT DIESEL ALLISON DIV.  
Rept. No. SAE-770255; 1977; 12P 9REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION, DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 865

## GAS EMISSIONS AND FUEL ECONOMY OF THE LIGHT DUTY DIESEL TRUCK

A COMPUTER PROGRAM IS USED TO PREDICT THE EFFECT OF ENGINE EMISSIONS, VEHICLE GEARING, TEST WEIGHT, AND DRIVING TECHNIQUE ON LIGHT DUTY DIESEL TRUCK EMISSIONS LEVELS. THE PROGRAM SIMULATES THE MECHANICS OF DRIVING A VEHICLE THROUGH A SPEED/TIME PROFILE. THE ENGINE SIMULATION WAS MODELED ON THE SIZE OF THE 6.247 BUT DEVELOPED TO THE SAME LEVEL OF EMISSIONS AS THE MERCEDES. TEST RESULTS ARE WELL WITHIN THE 2.3 GM/MILE FOR OXIDES OF NITROGEN AND THE 1.7 GM/MILE FOR HYDROCARBON PROPOSED FOR 1978 AND LATER MODEL YEAR LIGHT-DUTY DIESEL TRUCKS. THE LEVEL OF EMISSIONS CONTROL APPLIED IS SUCH THAT IF IT WERE APPLIED TO A PASSENGER CAR THE RESULTS WOULD BE AROUND 1.0 GM/MILE FOR OXIDES OF NITROGEN AND 0.5 GM/MILE FOR HYDROCARBON WITH FUEL ECONOMY IN EXCESS OF 24 MPG.

by R. GRAHAM FAIRWEATHER  
PERKINS ENGINES CO., UNITED KINGDOM  
Rept. No. SAE-770256; 1977; 12P  
PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION, DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 866

## RECENT CAV [LTD.] RESEARCH INTO NOISE, EMISSIONS, AND FUEL ECONOMY OF DIESEL ENGINES

THE CONTRIBUTION TO THE EXTERNAL NOISE FROM THE COMBUSTION PROCESS HAS BEEN CONSIDERED IN RELATION TO THE GASEOUS EMISSIONS, SMOKE, AND SPECIFIC FUEL CONSUMPTION. TO SATISFY THE REQUIREMENTS OF PROPOSED LEGISLATION IN DIFFERENT MARKETS, WHILE MAINTAINING ECONOMICAL OPERATION, THE FUEL INJECTION EQUIPMENT FOR A DIESEL ENGINE MUST COMPROMISE BETWEEN SEVERAL CONFLICTING REQUIREMENTS. THE CONFLICTS ARE PRESENTED IN THE FORM OF TRADE-OFF CURVES OVER A RANGE OF DYNAMIC INJECTION TIMINGS. FOUR MEANS TO ACHIEVE BETTER TRADE-OFF CURVES HAVE BEEN INVESTIGATED: HIGHER RATE OF INJECTION, FUMIGATION, TURBOCHARGING, AND TURBOCHARGING COMBINED WITH A HIGHER RATE OF INJECTION. ALL HAVE SHOWN PROMISING IMPROVE-

MENTS IN SOME OF THE TRADE-OFF CURVES WHICH HAVE BEEN DRAWN BETWEEN THE CONFLICTING REQUIREMENTS OF VARIOUS ASPECTS OF LEGISLATION AND FUEL ECONOMY. OF THE TWO WHICH ACT TO IMPROVE SMOKE, THE HIGH RATE OF INJECTION SHOWS AN IMPROVEMENT IN ECONOMY WHEREAS FUMIGATION SHOWS A DEGRADATION IN FUEL ECONOMY. BOTH PRODUCE A REDUCTION IN SMOKE AT THE RETARDED TIMINGS NECESSARY TO MEET THE GASEOUS EMISSIONS LEGISLATION. TURBOCHARGING APPEARS TO BE A MEANS FOR REDUCING NOISE WITHOUT SACRIFICE IN SPECIFIC FUEL CONSUMPTION OR SMOKE AT FULL LOAD CONDITIONS, PARTICULARLY WHEN COMBINED WITH HIGH RATE OF INJECTION, BUT THE NOISE OF THE TURBOCHARGED ENGINE INCREASES AS THE LOAD IS REDUCED, TO A PEAK NEAR HALF LOAD CONDITIONS. COMBINING TURBOCHARGING, REDUCTION OF THE RATED SPEED, AND INCREASE OF THE RATE OF INJECTION GAVE OVERALL IMPROVEMENTS IN ALL THE TRADE-OFF CURVES EXCEPT NITRIC OXIDE VERSUS SPECIFIC FUEL CONSUMPTION AT RETARDED TIMINGS. HOWEVER, THIS GAVE HIGHER PEAK PRESSURES WHICH MAY REQUIRE STRUCTURAL CHANGES TO THE ENGINE. ADDITION OF INTERCOOLING WILL REDUCE NITRIC OXIDE.

by M. F. RUSSELL  
CAV LTD., UNITED KINGDOM  
Rept. No. SAE-770257; 1977; 18P 9REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 867

#### **UNREGULATED EMISSIONS FROM DIESELS USED IN TRUCKS AND BUSES**

PARTICULATE, ODOR, SULFATE, SULFUR DIOXIDE, AND SELECTED NONREACTIVE HYDROCARBON EMISSIONS WERE MEASURED IN ADDITION TO THE REGULATED POLLUTANTS FROM DETROIT DIESEL 6V-71 AND 8V-71TA ENGINES AND A TURBOCHARGED CUMMINS 855 CU IN RESEARCH ENGINE. THE 855-TC ENGINE WAS RUN IN STANDARD AND A VARIABLE INJECTION TIMING CONFIGURATION, WHILE THE 6V-71 CITY BUS ENGINE WAS RUN WITH TWO TYPES OF INJECTOR DESIGNS. EMISSION RATES ARE SUMMARIZED IN TERMS OF GRAMS PER UNIT OF FUEL CONSUMED AND PER UNIT OF POWER OUTPUT. THE DATA ALLOW DIRECT COMPARISON BETWEEN ENGINES AND ENGINE CONFIGURATIONS, AS WELL AS A FUNCTION OF ENGINE SPEED AND LOAD CONDITION.

by KARL J. SPRINGER; RALPH C. STAHMAN  
SOUTHWEST RES. INST.; ENVIRONMENTAL  
PROTECTION AGENCY  
EPA-68-03-2116  
Rept. No. SAE-770258; 1977; 28P 20REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 868

#### **ORIGINS OF HYDROCARBON EMISSIONS FROM DIESEL ENGINES**

EXPERIMENTAL DATA ON THE CONCENTRATION OF HYDROCARBONS (HC) EMITTED IN THE EXHAUST ARE PRESENTED FOR BOTH DIRECT INJECTION AND INDIRECT INJECTION ENGINES AND COVER THE EFFECT OF A WIDE RANGE OF ENGINE OPERATING PARAMETERS. THE ANALYSIS SHOWS THAT THERE ARE TWO MAIN SOURCES OF HC IN DIRECT INJECTION ENGINES: FUEL EMPTYING FROM THE SAC AND HOLE VOLUME WHICH RESULTS IN FUEL RICH CONDITIONS AS FUEL ISSUES SLOWLY FROM THE NOZZLE, AND FUEL PREMIXED TO LEANER THAN LEAN LIMIT CONDITIONS. REDUCTION OF NOZZLE SAC VOLUME IS EFFECTIVE IN REDUCING THE SAC VOLUME SOURCE WHILE REDUCTION OF IGNITION DELAY IS EFFECTIVE IN REDUCING THE LEAN LIMIT SOURCE OF HS. THE LEAN LIMIT SOURCE OF HC IS PARTICULARLY IMPORTANT IN ENGINES OF RELATIVELY SMALL CYLINDER SIZE AND FOR PART LOAD HIGH SPEED CONDITIONS. IN INDIRECT INJECTION ENGINES THE LEAN LIMIT SOURCE OF HC IS A MAJOR CONTRIBUTOR. THE CONTRIBUTION BY THE SAC VOLUME IN THE PINTLE NOZZLE TO HC IS LESS IMPORTANT THAN THE SAC VOLUME IN DIRECT INJECTION ENGINES, BUT OTHER SOURCES OF FUEL-RICH HC, SUCH AS SECONDARY INJECTION, TO WHICH HIGH SPEED INDIRECT INJECTION DIESEL ENGINES ARE PRONE, CAN BE SIGNIFICANT. WITH BOTH ENGINE TYPES THERE IS THE POTENTIAL FOR ACHIEVING LOWER HYDROCARBON EMISSIONS THAN FORECAST LEGISLATION REQUIRES.

by G. GREEVES; I. M. KHAN; C. H. T. WANG; I. FENNE  
CAV LTD., UNITED KINGDOM  
Rept. No. SAE-770259; 1977; 20P 18REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 869

#### **REPEATABILITY OF SETUP AND STABILITY OF ANTHROPOMETRIC LANDMARKS AND THEIR INFLUENCE ON IMPACT RESPONSE OF AUTOMOTIVE CRASH TEST DUMMIES**

DUMMY POSITIONING REPEATABILITY, DYNAMIC STABILITY DURING RUNUP TO CRASH SPEEDS, AND THE SENSITIVITY OF DUMMY CRASH RESPONSE WERE INVESTIGATED USING PRECISION (FORCED INDEXING) AND CONVENTIONAL (SELF-CENTERING) SETUP PROCEDURES. THE STATIC REPEATABILITY AND DYNAMIC STABILITY TESTS WERE PERFORMED IN TEN DOMESTIC AND IMPORTED PRODUCTION VEHICLES. THE SENSITIVITY OF DUMMY RESPONSE TO SETUP METHODS WAS INVESTIGATED IN SLED TESTS. THERE IS SHOWN TO BE NO ADVANTAGE TO USING A PRECISION SETUP METHODOLOGY IN REAL VEHICLES SINCE SUCH METHODOLOGY MAY CAUSE LARGER DISPERSION OF ANTHROPOMETRIC POINTS THAN IS POSSIBLE BY USING THE NATURAL SELF-SEEKING BALANCED FORCE TECHNIQUE. UNDER DYNAMIC RUNUP TO CRASH SPEED CONDITIONS,



THERE IS NO ADVANTAGE WITH EITHER PROCEDURE FOR ACCELERATION LEVELS BELOW 0.25 G. THE CONVENTIONAL BALANCED FORCE PROCEDURE APPEARS TO HOLD AN EDGE OVER THE PRECISION PROCEDURE IN MAXIMIZING THE STABILITY OF ANTHROPOMETRIC INDEX POINTS. FOR DYNAMIC RESPONSE REPEATABILITY WITHIN THE SLED ENVIRONMENT, THE PRECISION METHOD HAS A SLIGHT ADVANTAGE IN REDUCING THE DISPERSION OF ACCELERATION MEASUREMENTS FOR THE HEAD AND ONLY A LITTLE ADVANTAGE, IF ANY, FOR THE CHEST. HOWEVER, IN TERMS OF DIFFERENCES BETWEEN MEAN RESPONSE VALUES OF DUMMY PAIRS, THE CONVENTIONAL SELF-CENTERING METHOD HOLDS THE ADVANTAGE FOR THE HEAD. THE DISPERSION OF PEAK BELT LOADS IS IN FAVOR OF THE CONVENTIONAL SETUP PROCEDURE IN TERMS OF LAP BELT AND PRACTICALLY NO ADVANTAGE IN SHOULDERBELT RESPONSES.

by S. BACKAITIS; E. ENSERINK  
NATIONAL HWY. TRAFFIC SAFETY  
ADMINISTRATION; DYNAMIC SCIENCES  
Rept. No. SAE-770260; 1977; 22P 4REFS  
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HS-022 870

#### PERFORMANCE EVALUATION OF THREE NEW-GENERATION ANTHROPOMORPHIC TEST DUMMIES

THE PERFORMANCE CHARACTERISTICS OF THREE ADVANCED 50TH PERCENTILE MALE ANTHROPOMORPHIC TEST DUMMY DESIGNS WERE QUANTITATIVELY EVALUATED. STATISTICAL ANALYSES WERE MADE OF REPLICATE MEASUREMENTS OF DUMMY ACCELERATIONS AND RESTRAINT SYSTEM LOADS TAKEN IN FOUR SLED TEST ENVIRONMENTS SIMULATING TYPICAL BELT, AIRBAG, AND VEHICLE INTERIOR CONFIGURATIONS. THE REPEATABILITY OF A PARTICULAR DUMMY DESIGN IS DEPENDENT ON BOTH TEST CONFIGURATION AND RESPONSE. STATISTICALLY SIGNIFICANT DIFFERENCES BETWEEN THE MEANS OF CERTAIN MEASURED RESPONSES OF DUMMIES OF A LIKE PAIR CAN EXIST EVEN THOUGH THE VARIANCES OR REPEATABILITY OF EACH ARE NOT SIGNIFICANTLY DIFFERENT. IN A COMPARISON OF THE THREE DESIGNS, PREFERRED CHARACTERISTICS ARE EVIDENT FOR DIFFERENT DUMMIES IN DIFFERENT TEST CONFIGURATIONS. HENCE, NO SINGLE DUMMY IS UNIVERSALLY BETTER IN ALL TEST CONFIGURATIONS AND FOR ALL MEASUREMENTS. SELECTION OF TEST PROCEDURES AND MEASUREMENTS TO BE USED IN COMPLIANCE TESTING OF RESTRAINT SYSTEMS SHOULD FAVOR CRITERIA THAT ARE CONSISTENT WITH MINIMUM DUMMY RESPONSE MEASUREMENT UNCERTAINTY.

by DANIEL E. MASSING  
CALSPAN CORP.  
Rept. No. SAE-770261; 1977; 15P 7REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 871

#### DUMMY DESIGN AND REACTION AT IMPACT SIMULATION

THE INFLUENCE OF NECK FLEXIBILITY ON THE HEAD INJURY CRITERION (HIC) OF THE HYBRID ANTHROPOMORPHIC DUMMY HAS BEEN INVESTIGATED IN SLED TESTS AT DIFFERENT SPEEDS. INCREASING NECK HARDNESS CAUSED A LINEAR DROP OF THE HIC VALUE; INCREASING SPEED CAUSED A PROGRESSIVE INCREASE OF THE HIC VALUE. IN SLED TESTS WITH SEAT BELTS, THE UPPER TORSO OF THE HYBRID-II DUMMY TWISTED OUT OF THE SHOULDER BELT, WHICH IS UNLAWFUL HUMAN BEHAVIOR; THE REASON FOR THIS BEHAVIOR MUST BE DETERMINED. WHEN COMPARING THE DUMMY CONSTRUCTION WITH THE ANATOMY OF THE HUMAN SKELETON, DIFFERENT KINEMATIC PROPERTIES CAN BE FOUND. DURABILITY OF THE DUMMY PARTS AND ADJUSTABILITY OF THE JOINTS GREATLY INFLUENCE A TROUBLE-FREE TEST COURSE AND GOOD REPEATABILITY OF THE RESULTS. THE USABILITY OF THE DUMMY CAN BE GREATLY EXTENDED BY THE PROPOSED STRUCTURAL CHANGES OF NECK, NECK ADAPTER, AND SHOULDER. SINCE THE DUMMY PROPERTIES ARE DEPENDENT ON ENVIRONMENTAL INFLUENCES, THE TEST METHODS FOR DUMMY PROPERTIES ARE OF GREAT IMPORTANCE.

by V. S. GERSBACH; P. M. MUSSELER  
BAYERISCHE MOTOREN WERKE AG, GERMANY  
Rept. No. SAE-770262; 1977; 16P 25REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 872

#### A SURVEY CONCERNING THE QUALITY OF PART 572 HYBRID II DUMMIES AS MEASURING INSTRUMENTS FOR CRASH TESTING

TWO PART 572 HYBRID II ANTHROPOMORPHIC DUMMIES OF DIFFERENT MANUFACTURE WERE EVALUATED TO DETERMINE DEVIATION FACTORS WHICH CAN BE ACCORDED TO VARIOUS INJURY CRITERIA AND OTHER MEASUREMENTS. TEN SERIES OF DUMMY COMPONENT CALIBRATIONS ACCORDING TO CFR49 - PART 572 AND FOUR SERIES OF NOMINALLY IDENTICAL SYSTEM SLED TESTS WERE MADE. EACH CALIBRATION PROCEDURE INVOLVED THE FOLLOWING TESTS: HEAD DROP, NECK PENDULUM, ABDOMINAL COMPRESSION, LUMBAR FLEXION, CHEST IMPACT, AND KNEE IMPACT. SYSTEM TESTING USING COMPLETE DUMMIES INCLUDED THE FOLLOWING WHICH SIMULATED REAL WORLD BEHAVIOR: HEAD DROP, IMPACT AGAINST CAR INTERIOR; NECK PENDULUM, ROTATION DURING IMPACT; ABDOMINAL COMPRESSION, RESPONSE TO LAP BELT; LUMBAR FLEXION, FORWARD BENDING DURING IMPACT; CHEST IMPACT, IMPACT AGAINST STEERING WHEEL/COLUMN IN RESPONSE TO DIAGONAL SEAT BELT; AND KNEE IMPACT, IMPACT AGAINST LOWER CAR INTERIOR. ALL STATISTICAL RESULTS ARE TABULATED. DEVIATION FACTORS

WITHIN A 30% BAND COULD BE ACCORDED TO THE IMPORTANT INJURY CRITERIA AND MEASUREMENTS.

by O. GEORGE G. O'CONNELL; RUNE ALMQVIST  
MOTOR INDUSTRY RES. ASSOC., ENGLAND; AB  
VOLVO CAR DIV., SWEDEN  
Rept. No. SAE-770263; 1977; 18P 7REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977. SUPPORTED IN PART BY  
TRANSPORT AND ROAD RES. LAB., UNITED  
KINGDOM.  
Availability: SAE

HS-022 873

## REVIEW OF TARGET DISCRIMINATION TECHNIQUES FOR AUTOMOTIVE RADAR APPLICATIONS

TYPES OF TARGETS PREDICTED FOR AUTOMOBILE RADAR INCLUDE OPERATIONAL TARGETS SUCH AS OTHER VEHICLES OR ROADSIDE OBJECTS, NATURAL TARGETS SUCH AS ANIMALS OR PLANT MATERIAL, AND MISCHIEVOUS TARGETS SUCH AS CHAFF OR INTENTIONAL JAMMING. DISCRIMINATION OF A RADAR TARGET IS BASED ON DECISION THEORY OR HYPOTHESIS TESTING THEORY; THE PROCESS IS FLOWCHARTED. IMPACT TRAJECTORY DISCRIMINATION IS POSSIBLE, PARTICULARLY WITH A MULTI-STATIC ANTENNA SYSTEM WHICH ESTABLISHES A LARGE SENSITIVITY ZONE IMMEDIATELY IN FRONT OF THE VEHICLE. VARIOUS TECHNIQUES OF ELECTROMAGNETIC DISCRIMINATION INCLUDE RADAR CROSS-SECTION ANALYSIS, SCATTERING MATRIX ANALYSIS, RESONANT FREQUENCY ANALYSIS, AND IMAGING ANALYSIS. THESE ARE DESCRIBED AND THEIR MATHEMATICAL EQUATIONS GIVEN. TRAJECTORY DISCRIMINATION WILL PROBABLY ALWAYS BE THE FIRST STEP IN TARGET DISCRIMINATION. RADAR CROSS-SECTION ANALYSIS MUST BE HIGHLY REFINED IN ORDER TO WORK IN THE AUTOMOTIVE RADAR APPLICATIONS, SINCE THE TECHNIQUE DOES NOT LEND ITSELF TO DISCRIMINATION OF TARGET TYPES OR DETERMINING TARGET FEATURES AND MATERIAL COMPOSITION. SCATTERING MATRIX ANALYSIS AND SCATTERING CENTER ANALYSIS ARE SUBJECT TO HIGH VARIABILITY WITH TARGET ASPECT ANGLE, WHEREAS RESONANT FREQUENCY ANALYSIS IS THEORETICALLY INDEPENDENT OF THIS FEATURE. RESONANT FREQUENCY ANALYSIS IS ALSO CONSIDERABLY MORE EFFICIENT IN TERMS OF COMPUTATION. THE TARGET DISCRIMINATION TECHNIQUE WHICH BEST HANDLES THE PROBLEM OF MULTIPLE TARGETS WILL BE THE MOST SUCCESSFUL CANDIDATE FOR AUTOMOTIVE RADAR USE.

by ROBERT M. STORWICK  
GENERAL MOTORS RES. LABS., GENERAL MOTORS  
TECHNICAL CENTER  
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## RESULTS FROM A COLLISIONS AVOIDANCE RADAR BRAKING SYSTEM INVESTIGATION

AN EXPERIMENTAL AND COMPUTER SIMULATION STUDY WAS CONDUCTED TO RESOLVE THE EFFECTS OF THE VARIOUS SYSTEM PARAMETERS WHICH MAY BE SIGNIFICANT TO THE TARGET RECOGNITION PROBLEM OF AUTOMOTIVE RADAR. AN INSTRUMENTED TEST VEHICLE EQUIPPED WITH AN AUTOMATIC/NONCOOPERATIVE RADAR BRAKING SYSTEM WAS USED TO GATHER PARAMETRIC DATA UNDER TYPICAL TRAFFIC CONDITIONS. TEST COURSES TYPIFIED MUCH OF THE HIGH DENSITY, HIGH SPEED, URBAN, AND SUBURBAN DRIVING IN THE U.S. DISCRIMINATION AGAINST FALSE TARGETS IS ACHIEVABLE PRIMARILY THROUGH RESTRICTING THE RADAR MAXIMUM DETECTION RANGE AND EMPLOYING A HIGHLY DIRECTIVE, LOW SIDELOBE ANTENNA; VALUES OF 150 FEET AND 2.5° BEAMWIDTH ARE ACCEPTABLE. HOWEVER, FALSE ALARMING DUE TO RADAR BACKSCATTER FROM HEAVY RAIN IS STILL A PROBLEM. COMPUTED BENEFITS ACCRUABLE TO SYSTEM OPERATION IN RAIN AND ON CURVED ROADS WERE SMALL BECAUSE OF THE LOW PERCENTAGE OF SERIOUS ACCIDENTS UNDER THESE CONDITIONS. DEGRADING OR SELF-INHIBITING PERFORMANCE IN THESE SITUATIONS MAY BE VIABLE. THE TRAFFIC ACCIDENT LIBRARY AND RADAR BRAKE MODEL ARE USEFUL TOOLS, AND THEY CAN BE BASELINE APPLIED TO EXPANDED ACCIDENT MODELS AND SYSTEMS WITH OTHER PARAMETRIC CONFIGURATIONS.

by WILLIAM C. TROLL; RICHARD E. WONG; YUNG KUANG WU  
BENDIX CORP., RES. LABS.; DEPARTMENT OF  
TRANSPORTATION  
DOT-HS-4-00913  
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## AN ASSESSMENT OF THE ACCIDENT AVOIDANCE AND SEVERITY REDUCTION POTENTIAL OF RADAR WARNING, RADAR ACTUATED, AND ANTI- LOCK BRAKING SYSTEMS

A GROUP OF 215 IN-DEPTH ACCIDENT REPORTS PREPARED AS PART OF A TRI-LEVEL ACCIDENT CAUSATION STUDY BY A MULTIDISCIPLINARY TEAM WAS EXAMINED TO ASSESS THE BENEFIT DERIVED FROM THE HYPOTHETICAL APPLICATION OF VARIOUS COMBINATIONS OF RADAR WARNING, RADAR ACTUATED, AND ANTILOCK BRAKING SYSTEMS. THE APPROACH WAS TO HAVE AN ACCIDENT ANALYST EVALUATE POST HOC THE BENEFIT WHICH WOULD HAVE BEEN DERIVED IF ONE OR MORE OF THE VEHICLES INVOLVED IN EACH ACCIDENT HAD BEEN EQUIPPED WITH VARIOUS TYPES AND COMBINATIONS OF THESE HYPOTHETICAL SYSTEMS. TEN SYSTEM TYPES OR COMBINATIONS WERE DEFINED: COOPERATIVE RADAR WARNING;

NONCOOPERATIVE RADAR WARNING; REAR WHEEL ANTILOCK; FOUR WHEEL ANTILOCK; COOPERATIVE RADAR WARNING AND REAR WHEEL ANTILOCK; NONCOOPERATIVE RADAR WARNING AND REAR WHEEL ANTILOCK; COOPERATIVE WARNING AND FOUR WHEEL ANTILOCK; NONCOOPERATIVE WARNING AND FOUR WHEEL ANTILOCK; COOPERATIVE RADAR WARNING AND ACTUATION, WITH FOUR WHEEL ANTILOCK; AND NONCOOPERATIVE RADAR WARNING AND ACTUATION WITH FOUR WHEEL ANTILOCK. TWO WHEEL ANTILOCK SYSTEMS BY THEMSELVES HAD RELATIVELY LITTLE ACCIDENT PREVENTION POTENTIAL: ONLY ONE OF THE 215 ACCIDENTS WOULD DEFINITELY HAVE BEEN PREVENTED BY SUCH A SYSTEM, ALTHOUGH WITH LESS ASSURANCE THERE WAS SOME POSSIBILITY OF PREVENTION OF UP TO EIGHT ACCIDENTS. THE MOST COMPLEX OF THE SYSTEMS DEFINED (NONCOOPERATIVE RADAR WITH BOTH ACTUATION AND WARNING POTENTIAL COUPLED WITH A FOUR-WHEEL ANTILOCK SYSTEM) WOULD DEFINITELY HAVE PREVENTED 39 OF THE ACCIDENTS, WITH SOME POSSIBILITY OF PREVENTION OF UP TO 90 ACCIDENTS.

by NICHOLAS S. TUMBAS; JOHN R. TREAT; STEPHEN T. MCDONALD  
INDIANA UNIV., INST. FOR RES. IN PUBLIC SAFETY  
DOT-HS-034-3-535  
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### **MICROCOMPUTER CONTROLLED RADAR AND DISPLAY SYSTEM FOR CARS**

AN EXPERIMENTAL, NONCOOPERATIVE AUTOMOTIVE RADAR DEVELOPED FOR COLLISION MITIGATION AND AUTOMATIC HEADWAY CONTROL HAS AN FM/CW RADAR INTERFACED WITH A MICROCOMPUTER WHICH HELPS ELIMINATE FALSE ALARMS AND WHICH HANDLES THE BRAKING, WARNING, AND HEADWAY CONTROL ALGORITHMS. THE BASIC OPERATIONAL SYSTEM IS AS FOLLOWS: DURING HIGHWAY DRIVING UNDER CRUISE CONTROL, THE RADAR MONITORS THE SPACE AHEAD AND IF THE VEHICLE APPROACHES ANOTHER CAR TOO CLOSELY THE CRUISE CONTROL IS DEACTIVATED AND A SAFE HEADWAY IS AUTOMATICALLY MAINTAINED. AS SOON AS THE PATH AHEAD IS CLEAR AGAIN, THE CRUISE CONTROL GOES BACK INTO OPERATION. THE RADAR ALSO PROVIDES AUDIBLE WARNING OF OBSTACLES OR OTHER CARS UP TO 30 METERS AHEAD, PARTICULARLY IMPORTANT WHEN DRIVING IN FOG. AN RCA COSMAC DEVELOPMENT SYSTEM USES THE 1801 MICROPROCESSOR. RANGE-FINDING ACCURACY IS TYPICALLY WITHIN PLUS OR MINUS .02 METERS. VARIOUS ROAD TESTS SHOWED THE SYSTEM TO BE FREE OF FALSE ALARMS. A SINGLE-LINE, SELF-SCAN PLASMA DISPLAY AND A SERIES OF SENSORS ALSO INTERFACE WITH THE COMPUTER TO PROVIDE NORMAL, DRIVING-RELATED INFORMATION OR WARNING MESSAGES, INCLUDING THE FOLLOWING: SERVICE BRAKE ON; DOORS

OPEN; RADAR WARN - SLOW DOWN; RESTRAINT SYSTEM OUT; ANTI SKID OUT; BRAKE FLUID LOW; OIL PRESSURE LOW; WATER TEMP HIGH; HAZARD. THE RADAR SYSTEM WAS DEVELOPED FOR MINICARS' RESEARCH SAFETY VEHICLE (RSV).

by E. BELOHOUBEK; J. CUSACK; J. RSKO; J. ROSEN  
RCA LABS., DAVID SARNOFF RES. CENTER  
Rept. No. SAE-770267; 1977; 12P 9REFS  
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### **ALUMINUM IN AUTOMOBILE BUMPER SYSTEMS**

ALUMINUM AS A MATERIAL IN VEHICLE BUMPERS IS OF INTEREST BECAUSE OF ITS HIGH STRENGTH/WEIGHT RATIO AND THE REQUIREMENTS OF FEDERAL MOTOR VEHICLE SAFETY STANDARD (FMVSS) 215, PART 581. EACH POUND OF ALUMINUM USED GENERATES 1.5 POUNDS OF DIRECT WEIGHT SAVINGS AND 0.75 POUNDS OF INDIRECT SAVINGS IN FRAMES, SUSPENSION MEMBERS, BRAKES, ETC. USE OF ALUMINUM IN BUMPERS TO DATE HAS SAVED FROM 80 TO 120 POUNDS OVER STEEL COUNTERPARTS. DESIGN CONCEPTS ARE BASED ON USE OF ALUMINUM AS EITHER THE MAIN STRUCTURAL MEMBER OR AS ITS INTEGRAL PART. EITHER EXTRUDED OR FABRICATED SHEET ALUMINUM CAN BE USED. RECOMMENDED ALLOYS INCLUDE 6061, 7005, AND 7046 (TO BE USED IN MILL FINISH CONDITION), AS WELL AS 7016 AND 7029 WHICH ARE BRIGHT ANODIZABLE. OTHER ACCEPTABLE ALLOYS ARE 7116 AND 7129. EQUATIONS USED IN STRUCTURAL DESIGN ANALYSIS ARE GIVEN. BUMPER SHAPE IN CROSS SECTION INFLUENCES WEIGHT; CHOICE OF DESIGN MUST TAKE INTO ACCOUNT BOTH WEIGHT SAVINGS AND FABRICATION COSTS. AS FOR PRODUCTION CAPABILITIES, ANY STEEL BUMPER PRODUCTION FACILITY CAN BE ADAPTED TO FORM ALUMINUM; A TYPICAL BUMPER FABRICATING SEQUENCE IS OUTLINED. ALUMINUM IS FINISHABLE BY ALL KNOWN TECHNIQUES SUCH AS ANODIZING, ELECTROPLATING, AND COATING WITH ORGANIC MATERIALS.

by DAVID E. HATCH  
REYNOLDS METALS CO.  
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### **STRUCTURAL DESIGN CONSIDERATIONS FOR ALUMINUM BUMPERS**

DESIGN OF ONE-PIECE ALUMINUM BUMPERS TO MEET 1980 IMPACT REQUIREMENTS INVOLVES CONSIDERATION OF ALLOY PROPERTIES, DENT RESISTANCE, BEAM STRENGTH, AND RELATIVE BEHAVIORS OF STEEL AND ALUMINUM. TEST DATA FOR DENTING AND A FINITE ELEMENT ANALYSIS

OF THE SECTION CAN BE USED TO ESTIMATE THICKNESS REQUIREMENTS AND THE ADEQUACY OF THE CROSS SECTION. AS THE SLOPE OF THE BUMPER INCREASED, SO DID SUSCEPTIBILITY TO DENTING. A FINITE ELEMENT ANALYSIS, BASED ON THE APPLICATION OF A STATIC LOAD EQUIVALENT TO THE DYNAMIC LOAD, PROVIDED A REASONABLE ESTIMATE OF THE STRESSES INCURRED IN THE DYNAMIC LOADING. AS LOAD IS APPLIED, THE SECTION DISTORTS NEAR THE CONTACT AREA AND AFFECTS DEFLECTIONS AND STRESSES. ELASTIC ANALYSIS CAN BE USED TO DEFINE THE RESISTANCE OF THE BUMPER TO PERMANENT SET FROM BENDING, WITH THE USE OF AN APPROPRIATE SHAPE FACTOR. STRAIN RATES IN THE TENSILE FLANGES OF THE C SECTION AND THE ALCOA SECTION WERE RELATIVELY LOW IN BENDING; THERE WOULD BE NO SIGNIFICANT ELEVATION OF THE YIELD STRENGTH IN EITHER ALUMINUM OR HIGH STRENGTH STEEL AT SUCH STRAIN RATES. DATA FOR DENTING IN ALUMINUM VERSUS THAT FOR STEEL SHOW THAT COMPARABLE PERFORMANCE WAS OBTAINED FOR PARTS OF APPROXIMATELY THE SAME YIELD STRENGTH AND THICKNESS. TESTS OF C SECTIONS MOUNTED ON ENERGY-ABSORBING UNITS SHOWED THAT THE LOAD ON THE ALUMINUM PARTS UNDER DYNAMIC CONDITIONS WAS 75% TO 95% OF THAT FOR STEEL PARTS OF COMPARABLE SIZE. THE WEIGHT OF AN ALUMINUM BUMPER WOULD BE 36% OF THAT OF A STEEL BUMPER OF COMPARABLE STRENGTH AND PERFORMANCE.

by M. L. SHARP; R. M. PETERS; R. B. WEISS  
ALUMINUM CO. OF AMERICA  
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**FIELD TESTING OF ALUMINUM AUTOMOTIVE ALLOYS**

AN EXTENSIVE FIELD TESTING PROGRAM OF ALUMINUM ALLOYS USED IN BUMPERS AND AUTOMOBILE BODIES INVOLVES TESTING OF FULL-SIZE ALUMINUM BUMPERS HAVING ANODIZED COATINGS, CHROME-PLATED COATINGS, TRANSPARENT COATINGS, AND OPAQUE COATINGS, AND TESTING OF BOTH BARE AND COATED BUMPER-STOCK PANELS OF ALLOYS X7016, X7116, X7046, AND X7029. OTHER TESTS ARE BEING MADE OF BIMETALLIC PANELS JOINED BY ADHESIVE BONDING AND WELD BONDING, AND OF BODY-FILLING REPAIRS USING BOTH IN-PLANT AND AFTER-MARKET TECHNIQUES. REPLICATE PANELS ARE TO BE REMOVED AFTER ONE, TWO, AND FOUR YEARS OF EXPOSURE AT FOUR ATMOSPHERIC CORROSION STATIONS: PHOENIX, ARIZ.; RICHMOND, VA.; CHICAGO, ILL.; AND POMPAÑO BEACH, FLA. ONE-YEAR REMOVALS AT THE ARIZONA AND FLORIDA LOCATIONS SHOW SATISFACTORY PERFORMANCE. CORROSION RATES WERE GREATER AT THE FLORIDA SITE, BUT ORGANIC COATINGS FARED WORSE AT THE ARIZONA SITE. THE ANODIZED ALLOYS

RETAINED THEIR APPEARANCE OF NEWNESS. BOTH EPOXY AND POLYESTER FILLERS APPEARED UNCHANGED. FOR BOTH ADHESIVE-BONDED AND WELD-BONDED ASSEMBLIES, THERE WAS SOME AS YET UNEXPLAINED VARIATION IN TEST RESULTS. IN MOST CASES, HOWEVER, SURFACE ABRASION PRIOR TO BONDING APPEARED TO IMPROVE BONDING DURABILITY.

by W. H. AILOR, JR.; T. L. WILKINSON, JR.  
REYNOLDS METALS CO.  
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**ADVANCES IN MULTI-FUNCTION GAS DISCHARGE DISPLAYS**

THE STATE OF THE ART OF NUMERIC, BAR GRAPH, POINTER BAR GRAPH, AND DOT MATRIX DISPLAYS FOR AUTOMOBILES IS PRESENTED. IN GENERAL THEY HAVE BECOME MORE RELIABLE, BRIGHTER, AND OFFER A VARIETY OF CONNECTION TECHNIQUES AND TRULY FLAT CONSTRUCTION. GAS DISCHARGE PANELS ARE SUITABLE FOR MULTIFUNCTION DISPLAYS. BAR GRAPHS ARE USEFUL FOR PRESENTING DIGITALLY ACCURATE INFORMATION IN AN ESSENTIALLY ANALOG FORM; FIVE-PHASE DEVICES HAVE A LARGE RANGE BECAUSE OF THEIR HIGHER MAXIMUM CURRENT. TYPICAL MULTIFUNCTION BAR GRAPHS ARE ILLUSTRATED. HYBRID BAR GRAPHS ARE THOSE WHICH HAVE SYMBOL OR DIGIT DISPLAYS IN ADDITION TO THE BAR GRAPH. THE POINTER BAR GRAPH COMBINES PRINTED CONSTRUCTION WITH INDIVIDUAL CELL SELECTION CAPABILITY; ADDITIONAL PHASES (TEN IN ALL) ARE NEEDED TO ENSURE ADEQUATE DEIONIZATION TIME. DOT MATRIX DISPLAYS ARE THE MOST VERSATILE; THEY CAN EVEN PRESENT GRAPHIC DISPLAYS SUCH AS SAFETY MESSAGES OR ROAD MAPS. A NEW FAMILY OF THICK FILM DOT MATRIX DISPLAYS WITH INTEGRATED CIRCUIT DRIVERS IS NOW BECOMING AVAILABLE. AS FOR CONNECTION TECHNIQUES, FIXED LEAD CONTACTS ARE BETTER ABLE TO WITHSTAND THE VIBRATION OF THE AUTOMOTIVE ENVIRONMENT. METHODS USED TO CALCULATE BRIGHTNESS AND DIMMING RANGE ARE GIVEN.

by JOHN A. SIEGEL  
BURROUGHS CORP., ELECTRONIC COMPONENTS DIV.  
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# **ON THE COMBINED EFFECTS OF TREAD ELEMENT FLEXIBILITY AND PAVEMENT MICROTEXTURE ON THIN FILM WET TRACTION**

A MATHEMATICAL MODEL WAS MADE TO STUDY THIN FILM WET TRACTION INCLUDING BOTH THE EFFECT OF A DEFORMABLE TREAD ELEMENT AND THAT OF PAVEMENT MICROTEXTURE. WHILE BOTH THESE FACTORS ARE IMPORTANT IN THIN FILM WET TRACTION, THE FORMER IS MORE SIGNIFICANT IN DETERMINING WHEN THE EXTREMITIES OF THE TREAD ELEMENT MAY CONTACT THE PAVEMENT. ON THE OTHER HAND, WHEN DEALING WITH A HARDER RUBBER, THE EFFECT OF PAVEMENT MICROTEXTURE BECOMES MORE PRONOUNCED, AND IN ALL CASES IT CAN INFLUENCE THE REAL AREA OF CONTACT. THE YOUNG'S MODULUS OF THE RUBBER HAS BEEN SHOWN TO HAVE A SIGNIFICANT EFFECT ON CONTACT TIME. WEAR CONSIDERATIONS MUST THEREFORE BE TAKEN INTO ACCOUNT IN OPTIMIZING THE TIRE/PAVEMENT PAIR FOR THIN FILM WET TRACTION, SINCE A SOFTER RUBBER USUALLY TENDS TO WEAR FASTER. THE EFFECT OF THE PAVEMENT MICROTEXTURE PATTERN IS ALSO SIGNIFICANT: A HARSHER PATTERN LEADS TO A CONSIDERABLY MORE RAPID DESCENT AND MAY HAVE ADDITIONAL DESIRABLE PROPERTIES IN THE CONTACT PHASE BETWEEN THE TIRE AND PAVEMENT.

by S. M. ROHDE  
GENERAL MOTORS CORP., RES. LABS.  
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# **A SEVEN SEGMENT NUMERIC DISPLAY FOR AUTOMOTIVE APPLICATIONS**

A SEVEN-SEGMENT NUMERIC DISPLAY FOR USE IN AUTOMOBILES HAS A LEADFRAME-REFLECTOR CAP STRUCTURE WITH A CAREFULLY SELECTED FILLER PLASTIC. IT PASSES TESTS OF MECHANICAL IMPACT, TEMPERATURE CYCLING, AND MOISTURE. THE LIGHT EMITTING DIODE (LED) CHIP IS GENERALLY 12-16 MILS SQUARE AND 7-10 MILS THICK; SEMICONDUCTOR MATERIAL VARIES ACCORDING TO LIGHT WAVELENGTH. BRIGHTNESS VARIES FOR RED, ORANGE, YELLOW, AND GREEN. THE EXPANSION COEFFICIENT OF THE PLASTIC USED IS TEN TIMES THAT OF THE STEEL USED FOR THE METAL CONDUCTORS IN THE PACKAGE. SMALL METAL PIECES ARE USED FOR CONDUCTORS WHICH FLOAT IN A PLASTIC MATRIX; DURING A TEMPERATURE CYCLE, THE STRESSES ARE ESSENTIALLY LOCAL STRESSES.

THE DEVICE IS MORE SENSITIVE TO CURRENT DENSITY THAN TO TEMPERATURE.

by RAYMOND E. BROWN  
MONSANTO COMMERCIAL PRODUCTS CO.,  
ELECTRONICS DIV.  
Rept. No. SAE-770272; 1977; 7P  
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# **AN AUTOMOTIVE INSTRUMENT PANEL EMPLOYING LIQUID CRYSTAL DISPLAYS**

AN INSTRUMENT PANEL CLUSTER CONSISTING OF FIVE TWISTED NEMATIC LIQUID CRYSTAL DISPLAYS HAS BEEN INSTALLED AND TESTED IN A CHEVROLET MONTE CARLO. THE DISPLAYS A WARNING INDICATORS, SPEEDOMETER, CLOD ODOMETER, FUEL GAUGE, AND TRANSMISSION DICATOR. FOUR MODES OF OPERATION FOR WARNING INDICATORS HAVE BEEN EVALUATED: TRANSMISSIVE, COLOR TRANSMISSIVE, REFLECTIVE, AND COLOR TRANSREFLECTIVE. AT PRESENT, TRANSPARENT AND REFLECTIVE DISPLAYS SEEM BEST SUITED FOR USE AS WARNING INDICATORS. THE REMAINING DISPLAYS ALL OPERATE IN THE REFLECTIVE MODE. BY MEANS OF HEATERS, THE SYSTEM IS CAPABLE OF OPERATING OVER A 0 TO 80° C RANGE. ADVANTAGES OF THE SYSTEM INCLUDE LOW VOLTAGE AND POWER REQUIREMENTS, EXCELLENT VISIBILITY IN BRIGHT SUNLIGHT, FLEXIBILITY OF DESIGN, COLOR CAPABILITY, AND REDUCED BULK. ADDITIONAL WORK IS STILL REQUIRED TO INCREASE THEIR TEMPERATURE RANGE (WITHOUT HEATERS) AND SHORTEN THEIR RESPONSE TIME.

by GEORGE W. SMITH; MICHAEL KAPLIT; DANIEL HAYDEN  
GENERAL MOTORS CORP., RES. LABS.  
Rept. No. SAE-770274; 1977; 11P 10REFS  
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# **VACUUM FLUORESCENT DISPLAYS FOR AUTOMOTIVE APPLICATIONS**

VACUUM FLUORESCENT DISPLAYS USED IN THE AUTOMOTIVE INDUSTRY INCLUDE NUMERICAL DISPLAYS FOR SUCH DEVICES AS CLOCKS, RADIO CITIZEN'S BAND RADIOS, SPEEDOMETERS, FUEL GAUGES, ANALOG DISPLAYS FOR SPEEDOMETERS AND GAUGES, AND ALPHANUMERIC DISPLAYS IN MESSAGE CENTERS. FLUORESCENT DISPLAYS CAN BE SEEN IN SUNLIGHT, AND THEY EXCEED ENVIRONMENTAL REQUIREMENTS FOR SHOCK, VIBRATION, AND TEMPERATURE RANGE. BASIC MATERIALS ARE GLASS, METAL, CARBON, AND PHOSPHOR. THE BASIC STRUCTURE IS SIMILAR TO THAT OF A TRIODE, SINCE IT IS COMPOSED OF A DIRECT

HEATED CATHODE, A CONTROL GRID, AND AN ANODE. DETAILS OF CONSTRUCTION, OPERATION, VIBRATION, AND SHOCK ARE GIVEN. THE VACUUM FLUORESCENT DISPLAY IS VERY PRACTICAL DUE TO ITS CIRCUIT COMPATIBILITY AND EASE OF SYSTEMS INTEGRATION. IT IS PRESENTLY AVAILABLE IN MANY STYLES AND HIGH VOLUME PRODUCTION.

by RAYMOND A. WEST  
FUTABA INDUSTRIES  
Rept. No. SAE-770275; 1977; 7P  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
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### PLANAR GAS DISCHARGE DISPLAYS FOR AUTOMOTIVE APPLICATIONS

SEGMENTED, RAISED CATHODE AND SEGMENTED, SCREENED CATHODE PLANAR GAS DISCHARGE (PGD) DISPLAYS ARE VIABLE IN AUTOMOTIVE INSTRUMENT CLUSTER APPLICATIONS. ESSENTIAL PRINCIPLES OF THEIR OPERATION, VIEWED CHARACTERISTICS, ELECTRONIC DRIVE REQUIREMENTS, ENVIRONMENTAL CONSIDERATIONS, AUTOMOTIVE ROAD TEST EXPERIENCE, SYSTEM RELIABILITY, AND RELATED APPLICATIONS EXPERIENCE ARE DISCUSSED. THE PGD DISPLAY CAN PROVIDE A VERY READABLE MESSAGE IN BOTH DIRECT SUNLIGHT AND TOTAL DARKNESS. TYPICAL RESPONSE TIME IN THE DC MODE IS 30 MICROSECONDS. VIEWING ANGLE IS USUALLY 130°. STANDARD DISPLAY CONFIGURATIONS ARE ILLUSTRATED. MINIMUM VOLTAGE REQUIREMENT IS USUALLY 160 VOLTS DC; MAXIMUM VOLTAGE IS NOT A DESIGN CONSTRAINT FACTOR. PGD DISPLAYS ARE DIMMED BY PULSING. "KEEP-ALIVE" CATHODES ARE USUALLY INCLUDED. PGD DISPLAYS ARE RECOMMENDED FOR MULTIPLEX APPLICATIONS, INCLUDING THOSE USING MOS/LSI LOGIC. AMBIENT TEMPERATURE CONDITIONS DO NOT AFFECT BRIGHTNESS OR CONTRAST. SOME PGD DISPLAYS WILL PROVIDE 100,000 HOURS OF LIFE WHEN OPERATED BETWEEN 0° C AND 70° C AT NOMINAL CURRENT AND DRIVEN DC; CONTINUOUS OPERATION AT EXCESSIVE LOW TEMPERATURE WILL, HOWEVER, DEGRADE LIFE EXPECTANCY. A MOISTURE RESISTANCE TEST SHOWED 0.4% FAILURE RATE UNDER GIVEN CONDITIONS. SHOCK AND VIBRATION TESTS HAVE NOT PRODUCED ANY CHANGE IN ELECTRICAL CHARACTERISTICS OR PHYSICAL DAMAGE. RADIATION LEVELS ARE QUITE LOW. RESPONSE SPEEDS ARE COMPATIBLE WITH TYPICAL ELECTRONIC DRIVE CIRCUITRY. VOLTAGE AND CURRENT LEVELS REQUIRED ARE ATTAINABLE WITH COMMERCIALLY AVAILABLE DC/DC CONVERTER TECHNIQUES. APPENDED ARE NAMES OF MANUFACTURERS, POTENTIAL SOURCES FOR CONVERTERS, REPRODUCTIONS OF ADVERTISEMENTS,

INFORMATION ABOUT THE LAGONDA'S INSTRUMENTATION, AND BACKGROUND PRODUCTION DATA.

by PAUL J. CORNELL  
BECKMAN INFORMATION DISPLAYS OPERATIONS  
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### DESIGN OF TIRE TREAD ELEMENTS FOR OPTIMUM THIN FILM WET TRACTION

FLEXIBLE TREAD ELEMENT SQUEEZE FILM ANALYSIS HAS BEEN USED TO DETERMINE THE EFFECT OF THREE CATEGORIES OF FACTORS TITLED TREAD ELEMENT GEOMETRY, TREAD RUBBER COMPOUND, AND ENVIRONMENT ON THIN FILM WET TRACTION PERFORMANCE. VARIOUS CHANGES ARE CONSIDERED IN TREAD ELEMENT GEOMETRY (SIZE, ASPECT RATIO, CIRCULAR VERSUS SQUARE SHAPE, REDUCED HEIGHT, ROUNDED EDGES), TREAD RUBBER COMPOUND (DIFFERENTIAL E (YOUNG'S MODULUS OF ELASTICITY) AND DIFFERENT E'S), AND ENVIRONMENT (INITIAL FILM THICKNESS, DIFFERENT MICRONS, PAVEMENT WAVINESS, AND VEHICLE SPEED). THE LOADING HISTORY EXPERIENCED BY A TREAD ELEMENT AS IT PASSES THROUGH THE FOOTPRINT WAS FOUND TO HAVE A MAJOR EFFECT ON THIN FILM WET TRACTION PERFORMANCE. DESIGN CHANGES ARE RECOMMENDED SOLELY ON THE BASIS OF TRACTION.

by ALAN L. BROWNE; DONALD WHICKER  
GENERAL MOTORS RES. LABS., ENGINEERING  
MECHANICS DEPT.  
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HS-022 887

### RATING TIRE TRACTION EFFECTIVENESS IN THE WINTER ENVIRONMENT

STATE OF THE ART TEST PROCEDURES AND TEST CONDITIONS ARE REVIEWED FOR MERIT AND POTENTIAL IMPROVEMENT, AND TRACTION DATA COVERING A TWELVE-YEAR PERIOD WITH 135 SPECIAL DESIGN WINTER TIRES AND 18 CONVENTIONAL TIRES ARE ANALYZED. THE FOUR BROAD TEST ENVIRONMENTS ARE VIRGIN SNOW, SOFT TO MODERATE PACKED SNOW, HARD PACKED SNOW, AND ICE (BOTH WET AND DRY). TEST PROCEDURES ARE CONFINED TO STATIC TRACTION, DYNAMIC TRACTION, AND STOPPING DISTANCE EVALUATIONS. VIRGIN SNOW TRACTION RESULTS HAVE THE GREATEST DEGREE OF VARIABILITY AMONG THE WINTER ENVIRONMENT TEST CONDITIONS; TEST CONDITIONS ARE POORLY DEFINED AND THE UNDERLYING SNOW BASE CAN VARY, AFFECTING TEST RESULTS. AS FOR SOFT TO MODERATE PACKED SNOW COMPARISONS, SPECIAL SNOW TIRES ARE

SHOWN TO BE SIGNIFICANTLY BETTER THAN CONVENTIONAL TIRES ALTHOUGH THERE IS A RELATIVELY CRITICAL RANGE OF OPERATING WHEEL SLIP FOR MAXIMUM TRACTIVE PERFORMANCE. LIMITED DATA FOR HARD PACKED SNOW COMPARISONS SHOW MORE SIMILARITY BETWEEN CONVENTIONAL AND SPECIAL TIRES THAN IN OTHER SNOW CONDITIONS. DYNAMIC ICE TRACTION GRAPHS FOR SPECIAL DESIGN AND CONVENTIONAL HIGHWAY TIRES SUGGEST A SIMILARITY IN TRACTIVE PROPERTIES FOR ICE AND HARD PACKED SNOW. IN ICE TRACTION COMPARISONS, DIFFERENCES IN PERFORMANCE LEVEL AND CURVE CHARACTERISTIC SHAPE BETWEEN SPECIAL AND CONVENTIONAL TIRES ARE MINIMAL, PARTICULARLY FOR WET ICE CONDITIONS. COMPARISON BETWEEN NEW VERSUS WORN SNOW TIRES SHOWS THAT TRACTION PERFORMANCE FOR ALL WORN TIRES IS SUBSTANTIALLY WORSE THAN THAT FOR COMPARABLE NEW TIRES. THE RATE OF TRACTION DECREASE WITH PROGRESSIVE TREADWEAR APPEARS TO BE A FUNCTION OF SPECIFIC TREAD DESIGN IN BOTH THE CENTER AND SHOULDER AREAS.

by J. E. FOOTIT  
ARMSTRONG RUBBER CO.  
Rept. No. SAE-770279; 1977; 12P 7REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 888

### **SOME UK [UNITED KINGDOM] PROGRESS IN SODIUM SULPHUR [SULFUR] TECHNOLOGY**

THE STATE OF THE ART OF SODIUM SULFUR CELLS FOR AUTOMOBILES IS REVIEWED. THE DEVELOPMENT OF SATISFACTORY ELECTROLYTE IS A COMPROMISE BETWEEN ELECTRICAL CONDUCTIVITY AND MECHANICAL STRENGTH. MOST OF THE DESIGN PROBLEMS ASSOCIATED WITH THE SODIUM ELECTRODE HAVE BEEN SOLVED. ELECTROLYTE 33 MM DIAMETER AND OVER 500 MM LONG CAN NOW BE PRODUCED AND THE STRENGTH AND CONDUCTIVITY CAN BE CONTROLLED. FACTORS CONTROLLING THE RECHARGEABILITY OF THE SULPHUR ELECTRODE HAVE BEEN STUDIED AND 90% CAPACITY RETENTION HAS BEEN ACHIEVED FOR 8000 HOURS WITHOUT ANY DETERIORATION OF PERFORMANCE. A 100 AHR CELL HAS COMPLETED 60 CHARGE DISCHARGE CYCLES WITHOUT ANY SIGNIFICANT DETERIORATION OF PERFORMANCE.

by G. R. LOMAX  
CHLORIDE SILENT POWER LTD., UNITED KINGDOM  
Rept. No. SAE-770280; 1977; 10P 23REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-022 889

### **THE EXCESS FUEL CONSUMED BY CARS WHEN STARTING FROM COLD**

A 1967 ROVER 2000 SALOON CAR AND A 1965 FORD MINIBUS WERE TEST DRIVEN TO DETERMINE THE EXTRA AMOUNT OF FUEL USED WHEN A CAR IS STARTED FROM COLD RATHER THAN FROM FULLY WARM. THE VEHICLES WERE STARTED FROM COLD AND DRIVEN UNDER EACH OF THE FOLLOWING CONDITIONS: AT STEADY SPEEDS OF 32, 48, 64, AND 80 KM/H; TO SIMULATE CONGESTED URBAN CONDITIONS, WITH MOMENTARY STOPS; AND TO SIMULATE RURAL DRIVING, WITH SPEEDS RISING FROM 48 TO 64 KM/H AND FALLING TO 48 KM/H AGAIN. THE RELATIONSHIPS BETWEEN THE EXTRA FUEL USED AND AIR TEMPERATURE AND METHOD OF DRIVING WERE DETERMINED. THE EXTRA FUEL USED IN STARTING FROM COLD WOULD BE SUFFICIENT TO ALLOW THE CAR TO TRAVEL AN ADDITIONAL 1.5 TO 2.5 KM; THIS DISTANCE INCREASES WITH DECREASE IN AIR TEMPERATURE AND INCREASES WITH INCREASE IN AVERAGE SPEED. AVERAGED OVER ALL TRIPS, THE FORMULAE MEASURED WHEN THE ENGINE WAS FULLY WARM WERE FOUND TO UNDERESTIMATE THE AMOUNT OF FUEL USED BY ABOUT 10%.

by P. F. EVERALL; J. NORTHROP  
TRANSPORT ROAD RES. LAB., ROAD SYSTEMS  
SECTION, CROWTHORNE, BERKS., ENGLAND  
Rept. No. TRRL-LR-315; 1970; 22P 4REFS  
Availability: CORPORATE AUTHOR

HS-022 890

### **SEAT BELT UTILIZATION BY CANADIAN AUTOMOBILE DRIVERS: ESTIMATES FROM A NATIONAL SURVEY**

THE EXTENT TO WHICH SEAT BELTS WERE USED BY CANADIAN AUTOMOBILE DRIVERS IN THE SPRING OF 1975 BEFORE INTRODUCTION OF ANY LEGISLATION MANDATING SEATBELT USE WAS ESTIMATED BY DIRECT OBSERVATION. RATES OF SEATBELT USE WERE LOW IN MAY 1975: IN ONLY ONE QUARTER OF ALL MILES DRIVEN AT THAT TIME WERE SEAT BELTS USED BY AUTOMOBILE DRIVERS, AND THE ESTIMATES FOR SMALLER POPULATION CENTERS AND LESS POPULOUS PROVINCES WERE CONSIDERABLY LOWER THAN THAT. IMPROVEMENTS IN THE COMFORT AND EASE OF USE OF SEATBELT SYSTEMS SINCE 1971, AND IN PARTICULAR THE INTRODUCTION OF INTEGRATED LAP AND SHOULDER SYSTEMS WITH SEQUENTIAL LOGIC WARNING SYSTEMS AND VEHICLE SENSITIVE RETRACTOR DEVICES, RAISED THE RATE OF SEATBELT UTILIZATION AMONGST DRIVERS OF CARS WITH SUCH FACILITIES. EVEN SO, HOWEVER, NO MORE THAN 50% OF ALL MILES DRIVEN IN SUCH CARS WERE DRIVEN BY DRIVERS WEARING SEAT BELTS. IT WOULD APPEAR, THEREFORE, THAT SEATBELT UTILIZATION CAN BE VIEWED AS A CLASSIC PUBLIC GOOD IN WHICH ALL INDIVIDUALS BENEFIT FROM LOWER HEALTH CARE COSTS ASSOCIATED WITH AGGREGATE INCREASES IN SEATBELT USE, BUT FEW INDIVIDUALS SEE A DIRECT MARGINAL BENEFIT TO



THEIR VOLUNTARY USE OF SEAT BELTS. IN SUCH SITUATIONS LEGISLATIVE COERCION IS TYPICALLY REQUIRED TO ASSURE COMPLIANCE WITH THE PUBLIC INTEREST, AND THE LEGISLATIVE INITIATIVE OF THE PROVINCE OF ONTARIO IS WELL JUSTIFIED IN THESE TERMS.

by H. M. STEVENSON; P. PESKUN; L. MITSON; J. TIBERT  
YORK UNIV., INST. FOR BEHAVIOURAL RES.,  
DOWNSVIEW, ONT., CANADA  
DOT-99954  
Rept. No. TP-1353; CR-7710; 1976; 124P 14REFS  
Availability: CORPORATE AUTHOR

HS-022 891

### A SURVEY TO DETERMINE THE LEVEL OF USE OF SEAT BELTS BY CANADIAN AUTOMOBILE DRIVERS

A SURVEY WAS MADE IN A ONE-WEEK PERIOD OF 1977 TO ESTIMATE THE PROPORTION OF AUTOMOBILE DRIVERS IN EACH CANADIAN PROVINCE WEARING SEATBELTS, THE MILES DRIVEN BY THOSE WEARING SEAT BELTS, AND VARIABLES OF SEATBELT USERS SUCH AS AGE, SEX, AGE OF AUTOMOBILE, AND TYPE OF SEATBELT ASSEMBLY. THE SURVEY YIELDED 16,978 OBSERVATIONS, MORE THAN HALF OF WHICH WERE IN MAJOR URBAN CENTERS. ABOUT HALF OF THE OBSERVATIONS WERE MADE DURING THE WEEKDAY AND ABOUT HALF DURING THE WEEKEND. NEARLY THREE QUARTERS OF THE DRIVERS OBSERVED WERE MALE. DRIVER'S AGE WAS ESTIMATED AS UNDER 45 YEARS OLD IN THREE QUARTERS OF THE OBSERVATIONS. THERE WAS LITTLE VARIATION IN AGE AND SEX AMONG PROVINCES. CONSIDERING THE COUNTRY AS A WHOLE, 29% OF DRIVERS WERE WEARING SEAT BELTS. THE LEVEL OF USE WAS HIGHEST IN THOSE PROVINCES WITH LEGISLATION REQUIRING THE MANDATORY USE OF SEAT BELTS (52% OF DRIVERS WERE WEARING THEM IN ONTARIO, AND 40% IN QUEBEC). SIMILARLY, IN PROVINCES CONSIDERING LEGISLATION, USE OF SEATBELTS BY DRIVERS EXCEEDED THE NATIONAL TOTAL. THE PROPORTIONS FOR SASKATCHEWAN AND BRITISH COLUMBIA WERE 32% AND 37% RESPECTIVELY. LESS THAN 10% OF DRIVERS WERE RECORDED AS WEARING SEAT BELTS IN NEWFOUNDLAND (8%), PRINCE EDWARD ISLAND (8%), AND MANITOBA (8%). THE MAJORITY (55%) OF CARS OBSERVED WERE MANUFACTURED IN THE YEARS 1974 TO 1977; 51% OF THE CARS OBSERVED WERE FITTED WITH INTEGRAL LAP/SHOULDER SEATBELT ASSEMBLIES.

CANADIAN FACTS CO. LTD., TORONTO, ONT., CANADA  
DSS-15ST.T8080-7-1237  
Rept. No. TP-1370; CR-7711; 1978; 109P  
Availability: CORPORATE AUTHOR

HS-022 892

### ENERGY LOSSES IN HEAVY COMMERCIAL VEHICLES

MAJOR VARIABLES TESTED TO DETERMINE THEIR INFLUENCE ON FUEL CONSUMPTION OF HEAVY COMMERCIAL VEHICLES INCLUDED THE FOLLOWING: ENGINE EFFICIENCY; TRANSMISSION LOSSES; LOAD; TIRE ROLLING RESISTANCE; AERODYNAMIC DRAG; GRADIENT OF ROUTE, AS WELL AS CORNERING AND SLEWING; SPEED; AND BRAKING AND ACCELERATION PATTERNS. MODERATE VARIABLES TESTED INCLUDED TYPE OF TIRE, EFFECTS OF WIND, TYPE OF TRANSMISSION, RATING OF ENGINE, THE DRIVER, AND SUCH AUXILIARY UNITS AS THE FAN AND COMPRESSOR. MINOR VARIABLES TESTED INCLUDED THE FOLLOWING: FUEL CALORIFIC VALUE; FUEL TEMPERATURE; RESIDUAL DRAG; STATE OF TIRE WEAR; AMBIENT TEMPERATURE; WEATHER CONDITIONS; ROAD SURFACE TEXTURE; AND TRAFFIC DENSITY ON TEST ROUTE. RESULTS ARE GRAPHED AND DISCUSSED. THE LARGEST PART OF THE POWER LOSS IS IN THE ENGINE. TIRES ACCOUNT FOR MUCH OF THE REMAINING POWER CONSUMPTION, SPECIFICALLY IN ROLLING RESISTANCE, CORNERING, AND SLEWING FORCES. THESE FORCES ALSO CONTRIBUTE TO THE TIRE WEAR AND WILL BE AFFECTED BY THE TYPE OF TIRE AND THE TIRE INFLATION PRESSURE. VEHICLE WARM-UP IS ESSENTIAL WHEN MAKING ANY COMPARISONS OF FUEL CONSUMPTION; WARM-UP AFFECTS NOT ONLY THE ENGINE BUT THE TRANSMISSION AND TIRES. AERODYNAMIC SHAPING CAN MATERIALLY IMPROVE FUEL CONSUMPTION IF VEHICLE SPEEDS ARE HIGH ENOUGH. THE PROBLEM OF COMPARATIVE TESTING WHERE WIND STRENGTHS ARE ABOVE CERTAIN MEAN LEVELS MUST BE CAREFULLY CONSIDERED. SOME ACCEPTED DRIVING CYCLE IS REQUIRED ON WHICH TO BASE ANY COMPARATIVE MEASUREMENTS; TEST ROUTES RATHER THAN TEST FACILITIES ARE RECOMMENDED FOR MULTI-AXLE VEHICLES.

by T. WILLIAMS  
TRANSPORT AND ROAD RES. LAB., TRANSPORT  
ENGINEERING DIV., CROWTHORNE, BERKS.,  
ENGLAND  
Rept. No. TRRL-SR-329; 1977; 52P 5REFS  
Availability: CORPORATE AUTHOR

HS-022 893

### ALCOHOL RELATED FATAL MOTOR VEHICLE TRAFFIC ACCIDENT STUDY, MICHIGAN: JANUARY-DECEMBER 1976

THERE WERE 883 ALCOHOL-RELATED FATAL TRAFFIC ACCIDENTS IN MICHIGAN OUT OF 1730 FATAL TRAFFIC ACCIDENTS, OR 51.0%, DURING 1976. THEY COST 1011 LIVES, OR 51.7% OF ALL MICHIGAN HIGHWAY FATALITIES FOR THAT YEAR. THERE WERE 2603 DRIVERS INVOLVED IN FATAL TRAFFIC ACCIDENTS, OF WHICH 894 DRIVERS OR 34.3% HAD BEEN DRINKING. OF THE 2603 DRIVER FATALITIES, 35.0% HAD BLOOD ALCOHOL TESTS; OF THESE, 53.4% HAD BLOOD ALCOHOL CONCENTRATIONS OVER THE LEGAL PRESUMPTIVE LIMIT. YOUNG DRIVERS AGES

24 YEARS OR YOUNGER ACCOUNTED FOR 49.3% OF DRIVERS WHO HAD BEEN DRINKING. THESE YOUNGER DRINKING DRIVERS HAD LOWER LEVELS OF ALCOHOL IN THEIR BLOOD, YET THEY HAD HIGHER INVOLVEMENT IN FATAL ACCIDENTS. ON THE OTHER HAND, MIDDLE AGED DRINKING DRIVERS HAD HIGHER LEVELS BUT LOWER INVOLVEMENT IN TRAFFIC ACCIDENTS. MAY WAS THE PEAK MONTH FOR ALCOHOL-RELATED FATAL TRAFFIC ACCIDENTS. IN ONLY 3.9% OF THE FATAL ACCIDENTS WERE INVESTIGATORS UNABLE TO DETERMINE THE DRINKING CONDITION OF THE DRIVERS INVOLVED. OF ALL FATAL ACCIDENTS IN WHICH DRINKING WAS INVOLVED, 63.0% OCCURRED ON FRIDAY, SATURDAY, OR SUNDAY, AND 58.6% OCCURRED BETWEEN 9 P.M. AND 3 A.M.

MICHIGAN DEPT. OF STATE POLICE, TRAFFIC ANALYSIS SECTION  
1977; 20P

Availability: CORPORATE AUTHOR

HS-022 894

#### **ANALYSES OF RIDING TESTS FOR EVALUATING THE WET BRAKING PERFORMANCES OF BICYCLES. FINAL REPORT**

THREE DIFFERENT TESTING APPROACHES FOR CALIPER-BRAKED BICYCLES ARE EXAMINED USING KINETIC ANALYSES, A REVIEW OF THE LITERATURE, AND AN EVALUATION OF AVAILABLE DOMESTIC AND FOREIGN TEST RESULTS. THE STUDY SHOWED THAT THE STOPPING DISTANCES OF BICYCLES ARE INCREASED UNDER WET-WEATHER CONDITIONS BECAUSE THE FRICTION COEFFICIENTS AT THE BRAKE SURFACES AND AT THE TIRE/PAVEMENT INTERFACES ARE REDUCED WHEN WET. ROAD TESTS TO EVALUATE WET BRAKING PERFORMANCES SHOULD INCLUDE WETTING OF BOTH THE BRAKE SURFACES AND THE TEST PAVEMENTS. ALUMINUM-ALLOY WHEEL RIMS PROVIDE SUBSTANTIALLY BETTER BRAKING PERFORMANCE, WHEN WET, THAN DO STEEL OR CHROME-PLATED RIMS; EMBOSING, SERRATING, OR DIMPLING OF RIMS DOES NOT CONSISTENTLY IMPROVE WET BRAKING PERFORMANCE. A STOPPING DISTANCE OF 10.28 M (33.7 FT) IS TENTATIVELY OFFERED AS A CRITERION FOR EVALUATING CALIPER-BRAKED BICYCLES UNDER WET CONDITIONS, ASSUMING A TEST CONFIGURATION CONFORMING TO PRESENT REQUIREMENTS OF THE CONSUMER PRODUCT SAFETY COMMISSION EXCEPT FOR THE WETTING. THIS WET STOPPING DISTANCE APPEARS TO BE SAFELY ATTAINABLE ONLY WITH BICYCLES HAVING ALUMINUM-ALLOY WHEEL RIMS. RANDOM VARIATIONS IN STOPPING DISTANCES ARE GREATER UNDER WET THAN UNDER DRY CONDITIONS. IT IS PROBABLE BUT NOT CONFIRMED THAT LAB REPRODUCIBILITY OF WET BRAKING TEST RESULTS WILL NOT BE SIGNIFICANTLY DIFFERENT THAN FOR DRY BRAKING TEST RESULTS.

by LEONARD MORDFIN  
NATIONAL BUREAU OF STANDARDS, INST. FOR MATERIALS RES., WASHINGTON, D.C. 20234  
Rept. No. NBSIR-78-1416; PB-276 398; 1977; 32P 39REFS  
Availability: NTIS

HS-022 895

#### **PERFORMANCE AND COST ANALYSIS OF CHASSIS DYNAMOMETERS**

TYPES, MAKES, AND MODELS OF LIGHT-DUTY CHASSIS DYNAMOMETERS ARE IDENTIFIED WHICH ARE PRESENTLY AVAILABLE COMMERCIALY, AND THOSE WHICH ARE SUITABLE FOR MEASURING EXHAUST EMISSIONS BY CURRENT FEDERAL TESTING PROCEDURE ARE COMPARED BY PERFORMANCE AND COST. THE FOUR DYNAMOMETERS WHICH MEET FEDERAL STANDARDS ARE PRODUCED BY BURKE E. PORTER MACHINERY CO., SUN ELECTRIC CORP., CLAYTON MANUFACTURING CO., AND LAB. EQUIPMENT CO. (LABECO). FACTORS CONSIDERED IN THE STUDY ARE ROLL CONFIGURATION, POWER ABSORPTION UNITS (PAU'S), INERTIA SIMULATION, AND COST. CLAYTON DYNAMOMETER ROLL CONFIGURATION GIVES ABOUT TWICE THE TIRE ROLLING RESISTANCE AS A FLAT ROAD, A 67-INCH DIAMETER SINGLE ROLL GIVES ABOUT THE SAME ROLLING RESISTANCE AS A FLAT ROAD, AND INTERMEDIATE CONFIGURATIONS HAVE INTERMEDIATE EFFECTS. THE CLAYTON DYNAMOMETER GIVES A STEEPER LOAD VERSUS SPEED CURVE THAN THAT EXHIBITED BY AN AVERAGE PASSENGER CAR, RESULTING IN DYNAMOMETER LOADS LESS THAN ACTUAL ROAD LOADS AT SPEEDS UNDER 50 MPH. AN ELECTRIC POWER ABSORPTION DYNAMOMETER IS ABLE TO DUPLICATE LOAD VERSUS SPEED CURVES TO WITHIN PLUS OR MINUS 3%, BUT REQUIRES ON-ROAD TORQUE MEASUREMENTS ON EVERY VEHICLE BEFORE EACH EMISSION TEST. IF SUCH MEASUREMENTS ARE NOT MADE, THEN AN ELECTRICAL DYNAMOMETER COULD BE SET TO GIVE A FIXED LOAD VERSUS SPEED CURVE SHAPE REPRESENTING THE MAJORITY OF VEHICLES; IT WOULD STILL BE MORE ACCURATE THAN PRESENT HYDROKINETIC UNITS WHICH UNDERLOAD THE AVERAGE PASSENGER CAR AT SPEEDS UNDER 50 MPH. REMAINING DIFFERENCES BETWEEN TRUE ROAD LOAD AT 50 MPH AND FEDERAL REGISTER VALUES, PARTICULARLY FOR LIGHT-DUTY TRUCKS, COULD BE MINIMIZED BY TAKING INTO ACCOUNT INDIVIDUAL VEHICLE AERODYNAMICS. THE EFFECT OF RELATIVE TIRE ROLLING RESISTANCE ON THE DYNAMOMETER IS STILL BEING STUDIED AND METHODS TO COMPENSATE FOR DIFFERENCES ARE BEING DEVELOPED. IF THE RELATIVE TIRE ROLLING RESISTANCE IS DIFFERENT BETWEEN THE ROAD AND THE CLAYTON DYNAMOMETER, SERIOUS CONSIDERATION SHOULD BE GIVEN TO A ROLL CONFIGURATION WHICH ACCURATELY SIMULATES THE ROAD. MECHANICAL INERTIA SIMULATION IS SUPERIOR TO THE ELECTRICAL TYPE; DIRECT-DRIVE OR POSITIVE-DRIVE FLYWHEEL SYSTEMS ARE RECOMMENDED.

by MICHAEL W. LEIFERMAN  
ENVIRONMENTAL PROTECTION AGENCY,  
STANDARDS DEVEL. AND SUPPORT BRANCH  
Rept. No. PB-272 148; LDTP-76-01; 1976; 24P 4REFS  
TECHNICAL SUPPORT REPT. FOR REGULATORY ACTION.  
Availability: NTIS

HS-022 896

# ENVIRONMENTAL IMPACT ASSESSMENT OF MOTORCYCLE EXHAUST: EMISSION REGULATIONS

THE ENVIRONMENTAL PROTECTION AGENCY IS PREPARING TO PROPOSE EMISSION STANDARDS FOR NEW MOTORCYCLES SOLD IN THE U.S. BETWEEN 1975 AND 1990, MOTORCYCLE EMISSIONS IF LEFT UNCONTROLLED, ARE EXPECTED TO INCREASE BY OVER 100%, WHILE EMISSIONS OF OTHER SOURCES WILL BE SIGNIFICANTLY CURTAILED; THUS MOTORCYCLE EMISSIONS WILL BECOME INCREASINGLY IMPORTANT. PRESENT UNCONTROLLED MOTORCYCLES EMIT ABOUT TWICE AS MUCH CARBON MONOXIDE (CO) AND ABOUT SIX TIMES AS MUCH HYDROCARBONS (HC) AS NEW 1976 AUTOMOBILES. WHEN STATUTORY STANDARDS FOR AUTOMOBILES ARE MET, UNCONTROLLED CO EMISSIONS OF MOTORCYCLES WILL BE TEN TIMES AS HIGH AND HC OVER TWENTY TIMES AS HIGH. THE PROPOSED INTERIM STANDARDS FOR 1978 FOR HC ARE DEPENDENT ON ENGINE DISPLACEMENT AND REQUIRE CONTROL TO 5 G/KM FOR MOTORCYCLES BETWEEN 50 AND 170 CC DISPLACEMENT. THE STANDARD INCREASES PROPORTIONATELY WITH DISPLACEMENT FROM 5 G/KM AT 170 CC TO 14 G/KM AT 750 CC; THE 14 G/KM STANDARD HOLDS FOR ALL MOTORCYCLES OVER 750 CC. CARBON MONOXIDE EMISSIONS ARE LIMITED TO 17 G/KM AND NITROGEN OXIDES (NOX) ARE LIMITED TO 1.2 G/KM. CRANKCASE HC EMISSIONS ARE PROHIBITED. THESE STANDARDS, IF MET THROUGHOUT THE LIFE OF THE MOTORCYCLE, WILL DECREASE AVERAGE EMISSIONS OF HC BY 30% AND CO EMISSIONS BY 22%. NITROGEN OXIDE EMISSIONS, WHICH ARE INHERENTLY QUITE LOW, WILL INCREASE SOMEWHAT AS HC AND CO ARE CONTROLLED. LONG-TERM STANDARDS FOR THE 1980 PRODUCTION YEAR WILL BE AT THE SAME LEVEL AS THOSE FOR LIGHT DUTY VEHICLES. CONTROL STANDARDS OF 0.25 G/KM HC AND 2.1 G/KM CO REPRESENT REDUCTIONS OF 95% AND 90% RESPECTIVELY. THERE ARE AT PRESENT ABOUT 4.9 MILLION MOTORCYCLES REGISTERED IN THE U.S.; THERE WILL PROBABLY BE OVER 11 MILLION BY 1990. THERE ARE RELATIVELY MORE MOTORCYCLES PER CAPITA IN THE PACIFIC AND WESTERN REGIONS OF THE U.S. ABOUT 15% OF THE MOTORCYCLE POPULATION IS SCRAPPED ANNUALLY. AS FOR ENVIRONMENTAL IMPACT, THE PROPOSED STANDARDS WILL REDUCE MOTORCYCLE EMISSIONS TO BELOW 0.1% AND 0.5% FOR HC AND CO RESPECTIVELY IN 1990. SECONDARY ENVIRONMENTAL BENEFITS WILL INCLUDE LOWER PARTICULATE AND SMOKE EMISSIONS FROM MOTORCYCLES, LOWER PHOTOCHEMICAL REACTIVITY OF THE HYDROCARBONS, SLIGHT POTENTIAL REDUCTIONS IN STREET SURFACE RUN-OFF POLLUTION, AND IMPROVED MOTORCYCLE FUEL ECONOMY, AT LEAST IN PRODUCTION YEARS 1978 AND 1979. POTENTIAL DISADVANTAGES WILL BE SLIGHT INCREASES IN NITROGEN OXIDES, POSSIBLE SULFATE EMISSIONS FROM POST-1979 MOTORCYCLES, AND THE UNKNOWN COMPATIBILITY OF EMISSION CONTROLS WITH FUTURE REGULATIONS OF MOTORCYCLE NOISE. COST ESTIMATES OF ACHIEVING THE PROPOSED STANDARDS ARE HIGHLY UNCERTAIN,

BUT COST EFFECTIVENESS WILL BE GREATEST FOR THE DIRTIER, LARGE TWO-STROKE MOTORCYCLES. THE 100 LARGEST STANDARD METROPOLITAN STATISTICAL AREAS ARE RANKED BY RATIO OF REGISTERED MOTORCYCLES PER 100 POPULATION.

ENERGY AND ENVIRONMENTAL ANALYSIS, INC.,  
1701 N. FORT MYER DRIVE, SUITE 1211, ARLINGTON,  
VA.  
Rept. No. PB-258 685; 1975; 87P  
Availability: NTIS \$5.00 PAPER COPY, \$3.00 MICROFICHE

HS-022 897

## MOTORCYCLE USAGE

URBAN MOTORCYCLE USAGE DATA FROM THE 1974 GALLUP MOTORCYCLE SURVEY ARE PRESENTED AND ARE RELATED TO THE PROPOSED FEDERAL TEST PROCEDURE FOR TESTING MOTORCYCLES. THE AVERAGE URBAN TRIP LENGTH FOR STREET LEGAL MOTORCYCLES IS 5.2 MILES; AVERAGE TRIP FREQUENCY IS 3.2 TRIPS PER DAY (IN THE MONTH OF MAY); AND AVERAGE SPEED FOR COMMUTING TRIPS IS 29 MPH. SMALL DISPLACEMENT MOTORCYCLES ARE USED LESS FREQUENTLY AND OVER SHORTER DISTANCES AT LOWER SPEEDS. OVER ONE HALF THE LARGE DISPLACEMENT MOTORCYCLES BUT SLIGHTLY LESS THAN 20% OF THE SMALL DISPLACEMENT MOTORCYCLES USE THE FREEWAYS FOR COMMUTING. LIGHT DUTY VEHICLE WEIGHTING FACTORS SHOULD BE USED FOR CALCULATING EMISSIONS FROM UNCONTROLLED AND 1978 LEVEL CONTROLLED MOTORCYCLES. THE EFFECT OF WEIGHTING FACTORS ON CALCULATED EMISSIONS WILL BECOME MORE IMPORTANT AS EMISSIONS FROM MOTORCYCLES ARE CONTROLLED, AND THE DETERMINATION OF MORE ACCURATE WEIGHTING FACTORS SPECIFIC TO MOTORCYCLES WOULD BE RECOMMENDED. USAGE DATA FROM THE GALLUP SURVEY ARE NOT SUFFICIENT TO DETERMINE IF A DIFFERENT DRIVING CYCLE FOR MOTORCYCLES IS NEEDED. QUESTIONS FROM THE GALLUP SURVEY ARE APPENDED.

ENVIRONMENTAL PROTECTION AGENCY,  
STANDARDS DEVEL. AND SUPPORT BRANCH, ANN  
ARBOR, MICH. 48105  
Rept. No. MC-76-02; PB-270 710; 1976; 14P  
TECHNICAL SUPPORT REPT. FOR REGULATORY  
ACTION.  
Availability: NTIS

HS-022 898

## THE STOP SIGN IS FOR THE OTHER GUY: A NATURALISTIC OBSERVATION OF DRIVING BEHAVIOR OF NIGERIANS

EFFECTS OF TWO TYPES OF STOP SIGNS ON DRIVING BEHAVIORS OF DRIVERS OF PRIVATE CARS AND COMMERCIAL VEHICLES WERE EXAMINED USING 1211 MALE AND FEMALE NIGERIANS DRIVING THROUGH A COMPLEX T JUNCTION, BOTH BEFORE AND AFTER INSTALLATION OF A STOP SIGN. TRAINED OBSERVERS RECORDED HOW FAR EACH DRIVER CONFORMED WITH THE DEMANDS OF STAND-

DARD TRAFFIC REGULATIONS. PRIVATE-CAR DRIVERS CONFORMED MORE TO TRAFFIC REGULATIONS THAN DID DRIVERS OF COMMERCIAL VEHICLES; THOSE WHO OBEY STOP SIGNS TEND TO MAKE TURN SIGNALS AS WELL.

by DENIS CHIMAEZE E. UGWUEGBU  
 Publ: JOURNAL OF APPLIED PSYCHOLOGY V62 N5  
 P574-7 (1977)  
 1977; 4REFS  
 SUPPORTED BY UNIVERSITY OF IBADAN, DEPT. OF  
 ADULT EDUCATION.  
 Availability: SEE PUBLICATION

HS-022 899

### IMPACTS OF EUROPEAN CARS AND A PASSENGER COACH [BUS] AGAINST SHAPED CONCRETE BARRIERS

MODIFIED VERSIONS OF THE POPULAR NEW JERSEY STATE HWY. AUTHORITY'S SHAPED CONCRETE BARRIER WERE TESTED BY IMPACTING A LEYLAND 1800, A LEYLAND MINI, AND AN AEC RELIANCE BUS TO ASSESS THE BARRIER'S SUITABILITY FOR EUROPEAN CARS. THE TESTS SHOWED THAT THE NEW JERSEY PROFILE DOES NOT OVERTURN LEYLAND MINI CARS WHICH STRIKE THE BARRIER AT A SPEED AND ANGLE OF 90 KM/H AND 20° APPROPRIATE TO THAT WHICH CAN BE GENERATED WHEN A CAR VEERS ACROSS A TWO-LANE ROADWAY. HOWEVER AT AN APPROACH OF 113 KM/H AND 20°, APPROPRIATE TO A THREE-LANE ROADWAY, A MINI CAR WAS ROLLED OVER TOWARDS THE BARRIER. LOWERING THE HEIGHT OF THE NEW JERSEY BARRIER BY 75 MM PREVENTED ROLLOVER OF THE MINI AT 113 KM/H AND 20°, SO THAT THIS BARRIER SHAPE, ESSENTIALLY THE SAME AS THE AMERICAN CONFIGURATION F, IS CONSIDERED TO BE ACCEPTABLE ON MOST ROADS IN THE UNITED KINGDOM. OVERLAYS OF THE ROAD SURFACE WILL MINIMIZE THE BENEFITS OF THE PROFILE IN CASUAL IMPACTS. WHEN THE NEW JERSEY BARRIER WAS RAISED 75 MM IN RELATION TO THE ROAD SURFACE THE RESULTS INDICATED THAT THE LEYLAND MINI WILL ROLL OVER AWAY FROM THE BARRIER EVEN AT AN APPROACH OF 90 KM/H AND 20° APPROPRIATE TO A TWO-LANE ROADWAY.

by V. J. JEHU; L. C. PEARSON  
 TRANSPORT AND ROAD RES. LAB., BRIDGE  
 CONSTRUCTION DIV., CROWTHORNE, BERKS.,  
 ENGLAND  
 Rept. No. TRRL-LR-801; 1977; 25P 2REFS  
 Availability: CORPORATE AUTHOR

HS-022 900

### CAR OWNERSHIP TRENDS AND FORECASTS

STATISTICAL ANALYSES WERE MADE OF BRITISH, U.S., AND OTHER DATA ON CURRENT LEVELS OF CAR OWNERSHIP IN DIFFERENT AREAS, COMPARISONS OF GROWTH RATES IN DIFFERENT AREAS, AND STUDIES OF LONG-TERM GROWTH PATTERNS IN ORDER TO FORECAST FUTURE GROWTH OF ROAD TRAFFIC BASED ON AUTOMOBILE OWNERSHIP. OVERRIDING SUCH EFFECTS AS INCOMES AND

POPULATION DENSITIES IS A STRONG TENDENCY FOR THE ANNUAL PERCENTAGE GROWTH RATES OF CAR OWNERSHIP TO REDUCE AS THE LEVEL OF OWNERSHIP RISES. THE LOGISTIC CURVE MODEL USED IN PREVIOUS WORK IS NOT SUFFICIENTLY GENERAL; AN ALTERNATIVE ALGEBRAIC FORM IS PROPOSED WHICH HELPS TO RECONCILE AN APPARENT INCONSISTENCY BETWEEN THE RECENT RAPID SLOWING DOWN OF GROWTH IN GREAT BRITAIN AND OTHER EVIDENCE THAT SUGGESTS THAT SATURATION IS STILL SOME WAY OFF. A RANGE OF FORECASTS OF NUMBERS OF CARS MADE ON THE BASIS OF THE NEW MODEL AND ALTERNATIVE ASSUMPTIONS ABOUT FUTURE LEVELS OF ECONOMIC GROWTH AND OF FUTURE PRICES. WITH THE MIDDLE ASSUMPTIONS, THE NEW FORECASTS ARE SOMEWHAT LOWER THAN THOSE ISSUED PREVIOUSLY, AT LEAST UP TO 1990. THEREAFTER THEY MAY BE HIGHER OR LOWER, DEPENDING ON THE SATURATION LEVEL CHOSEN.

by J. C. TANNER  
 TRANSPORT AND ROAD RES. LAB., ACCESS AND  
 MOBILITY DIV., CROWTHORNE, BERKS., ENGLAND  
 Rept. No. TRRL-LR-799; 1977; 123P 53REFS  
 Availability: CORPORATE AUTHOR

HS-022 901

### TRAFFIC-CRASH FATALITIES (1968-73): INJURY PATTERNS AND OTHER FACTORS

INJURY PATTERNS ARE STUDIED IN 1004 TRAFFIC CRASH FATALITIES OCCURRING IN BRISBANE, QUEENSLAND, AUSTRALIA, BETWEEN JUL 1968 AND JUN 1973. THERE WERE 331 CAR DRIVERS, 225 CAR PASSENGERS, 306 PEDESTRIANS, 76 MOTORCYCLISTS, 29 PEDALCYCLISTS, AND 37 IN OTHER PARTICIPANT CATEGORIES. OF THE 1004 FATALITIES, 733 WERE MALE AND 271 FEMALE. DETAILS OF THE AGE, SEX, AND PARTICIPANT CATEGORIES ARE TABULATED AS ARE THE DISTRIBUTION OF HEAD, CHEST, ABDOMINAL, NECK, SPINE, PELVIS, AND LIMB-FRATURE INJURIES. EXCEPT FOR MOTORCYCLISTS, THE HEAD WAS THE REGION MOST FREQUENTLY INJURED; FOR MOTORCYCLISTS THE CHEST WAS THE AREA MOST FREQUENTLY INJURED. THERE WAS AN AVERAGE OF SIX INJURIES FOR EACH OF THE TOTAL FATALITIES. COMPARISON WITH DATA OF INJURIES OVER THE PERIOD 1935-1968 SHOWED THAT THERE HAS BEEN A REDUCTION IN HEAD INJURIES AND A SIGNIFICANT INCREASE IN CHEST AND LIMB INJURIES. OF THE TOTAL FATALITIES, 48.9% WERE DEAD WITHIN ONE HOUR OF THE ACCIDENT. THE MOST COMMON CAUSE OF DEATH WAS HEMORRHAGE (29% OF CASES). BLOOD ALCOHOL DETERMINATIONS WERE MADE FOR 625 OF THE FATALITIES AT THE TIME OF NECROPSY; 31.8% HAD ALCOHOL LEVELS IN EXCESS OF 100 MG/100ML, AND 59.3% OF DRIVER FATALITIES TESTED HAD ALCOHOL LEVELS IN EXCESS OF 100 MG/100 ML. DISEASE OF THE DRIVER WAS CONSIDERED RESPONSIBLE FOR THE CRASH IN 23 INSTANCES, OR 0.6%. SEAT BELTS WERE WORN BY 14% OF THE DRIVERS AND BY 12.1% OF THE PASSENGERS. OF THE 89 MOTORCYCLIST, MOTORSCOOTERISTS, AND PILLION PASSENGERS KILLED, HELMET INFORMATION WAS AVAILABLE

September 30, 1978

HS-022 904

FOR 51; OF THESE, ALL BUT TWO WERE WEARING HELMETS. LEGISLATION REQUIRING USE OF MOTORCYCLE HELMETS AND AUTOMOBILE SEAT BELTS IS SHOWN TO BE EFFECTIVE IN REDUCING FATALITIES. QUALITY OF AMBULANCE SERVICES IS ALSO A FACTOR IN REDUCING FATALITIES, AS IS THE QUALITY OF EMERGENCY TREATMENT IN HOSPITALS. NO SIGNIFICANT CHANGE CAN BE SEEN IN BLOOD-ALCOHOL LEVELS IN TRAFFIC FATALITIES WHEN COMPARED WITH EARLIER SURVEYS.

by J. I. TONGE; M. J. J. O'REILLY; A. DAVISON; N. G. JOHNSTON; I. S. WILKEY  
Publ: MEDICINE, SCIENCE AND THE LAW V17 N1 P9-24  
(JAN 1977)  
1977; 7REFS  
Availability: SEE PUBLICATION

HS-022 902

#### **MATERIALS - AUTOMOTIVE FITNESS. SHAPE UP OR DROP OUT**

LIGHTWEIGHT MATERIALS SUITABLE FOR REDUCING AUTOMOBILE WEIGHT INCLUDE HIGH-STRENGTH STEELS, ALUMINUM, GLASS-REINFORCED PLASTIC (GRP), AND ADVANCED FIBER-REINFORCED PLASTIC (FRP). ENGINEERING CHARACTERISTICS TO BE CONSIDERED INCLUDE YIELD STRENGTH, TENSILE MODULUS, FATIGUE STRENGTH, AND FORMABILITY; COST IS ALSO AN IMPORTANT FACTOR. STEELS ARE USUALLY OF THE HIGH-STRENGTH LOW-ALLOY (HSLA) TYPE FORMED INTO THINNER AND THUS LIGHTER SECTIONS; ALTHOUGH THEIR STIFFNESS REQUIRES CARE IN DESIGN, THEIR LOW COST AND THEIR IMPROVED CORROSION RESISTANCE MAKE THEM ATTRACTIVE MATERIALS. THE ADVANTAGES OF ALUMINUM INCLUDE WEIGHT AND STIFFNESS ABOUT ONE THIRD THOSE OF STEEL; DISADVANTAGES ARE COST AND CYCLE TIMES. INNOVATIVE TECHNIQUES HAVE BEEN DEVELOPED FOR FORMING ALUMINUM. ELASTOMERS, UNREINFORCED PLASTIC PARTS, AND PLASTIC COMPONENTS WITH FIBER REINFORCEMENT SERVE A VARIETY OF AUTOMOTIVE DESIGN NEEDS FOR MATERIALS WITH SUCH FACTORS AS HEAT RESISTANCE, RESISTANCE TO FLUID ATTACK, EASE OF FABRICATION, AND LOW COST. PLASTICS REINFORCED WITH GLASS AND WITH OTHER FIBERS SUCH AS CARBON, ARAMID, AND BORON INCREASE STRENGTH AND STIFFNESS. THE MOST PROMISING USE OF GRP'S IS AS SHEET MOLDING COMPOUNDS TO BE USED LIKE SHEET METAL. ALTHOUGH THE ADVANCED COMPOSITES ARE IDEAL FROM AN ENGINEERING VIEWPOINT, THEY CAN BE EXPENSIVE. IT IS NOT YET CLEAR THAT INNOVATIVE MATERIALS WILL BE COMPATIBLE WITH CURRENT SAFETY OR CRASHWORTHINESS REGULATIONS, SINCE THOSE REGULATIONS ARE WRITTEN IN TERMS OF STEEL DEFORMABILITY.

by DENNIS SIMANAITIS  
Publ: ROAD AND TRACK V29 N9 P121-5 (MAY 1978)  
1978  
Availability: SEE PUBLICATION

HS-022 903

#### **WHY YOU SHOULDN'T BELIEVE THE FEDS BODY COUNT**

THE CLAIM BY THE NATIONAL HWY. TRAFFIC SAFETY ADMINISTRATION (NHTSA) THAT THE 55 MPH SPEED LIMIT HAS RESULTED IN A 50% REDUCTION IN TRAFFIC FATALITIES IS CHALLENGED; THE 55 MPH SPEED LIMIT HAS IN FACT ACCOUNTED FOR NO FATALITY REDUCTIONS AT ALL. AS FOR ITS FUEL ECONOMY BENEFITS, THE LAW HAS MADE ONLY A 1% IMPROVEMENT IN FUEL ECONOMY. A CHANGE IN DEFINITION OF TRAFFIC FATALITIES MAKES NHTSA FIGURES MISLEADING, AND STATISTICS FOR ACCIDENTS OCCURRING BELOW 55 MPH AND FOR PEDESTRIAN FATALITIES ARE NOT PROPERLY CONSIDERED IN NHTSA STATEMENTS. INCREASED USE OF SEAT BELTS IS ALSO RESPONSIBLE FOR REDUCED FATALITIES, AS ARE OTHER IMPROVEMENTS IN AUTOMOBILE DESIGN AND STRICTER DRIVER LICENSING REQUIREMENTS AND VEHICLE INSPECTIONS. THE 55 MPH SPEED LIMIT IS A MISGUIDED ATTEMPT TO RESTRICT THE AMERICAN PEOPLE. THE TRAFFIC FATALITY RATE IS UNPREDICTABLE, EXCEPT FOR AN UNSHAKABLE CORRELATION WITH THE FEDERAL RESERVE BOARD'S INDUSTRIAL PRODUCTION INDEX; THE FATALITY RATE INCREASES AS IT INCREASES, AND VICE VERSA. SPEEDING IS ONLY ELEVENTH ON THE LIST OF CAUSES OF TRAFFIC FATALITIES, ACCORDING TO CALIFORNIA STATISTICS.

by RICH TAYLOR  
Publ: CAR AND DRIVER V23 N11 P75-6, 81-3 (MAY 1978)  
1978  
Availability: SEE PUBLICATION

HS-022 904

#### **INFORMATION DOCUMENTS ON AUTOMOBILE EMISSIONS INSPECTION AND MAINTENANCE PROGRAMS. FINAL REPORT**

IN CONFORMANCE WITH THE CLEAN AIR ACT AMENDMENTS OF 1977 (PUBLIC LAW 95-95), INFORMATION REGARDING THE PROCESSES, PROCEDURES, AND METHODS TO REDUCE OR CONTROL MOTOR VEHICLE EMISSIONS BY INSPECTION AND MAINTENANCE PROGRAMS (SECTION 108 (F) (L) (A) (I)) ARE PRESENTED. INSPECTION/MAINTENANCE PROGRAMS SUPPLEMENT THE EXISTING FEDERAL MOTOR VEHICLE EMISSION CONTROL PROGRAM. UNDER THE PROGRAM, ALL VEHICLES FOR WHICH EMISSION REDUCTIONS ARE CLAIMED MUST RECEIVE REGULAR, PERIODIC INSPECTIONS, FAILED VEHICLES MUST PASS A RETEST FOLLOWING MAINTENANCE, AND QUALITY CONTROL MEASURES MUST BE FOLLOWED. LOADED MODE TESTING IS THE RECOMMENDED TYPE OF INSPECTION. LEGISLATION PROHIBITS DELIBERATE TAMPERING OR REMOVAL OF AIR POLLUTION CONTROL DEVICES. MOTORCYCLES AND HEAVY DUTY TRUCKS SHOULD NOT BE EXEMPTED. ANNUAL INSPECTION IS RECOMMENDED. STANDARDS FOR EMISSIONS SHOULD BE SET AT A POINT THAT BALANCES AIR-QUALITY BENEFITS WITH IMPACT ON THE PUBLIC. PREVIOUS

ESTIMATES OF EMISSION DETERIORATION MAY HAVE BEEN TOO HIGH; OVERALL EFFECTIVENESS OF THE INSPECTION/MAINTENANCE PROGRAM IN THE FIRST YEAR WOULD BE ABOUT 70% OF THE IMMEDIATE REDUCTION FOLLOWING REPAIR AT THE START OF THE YEAR. DETERIORATION OVER TIME IS ASSUMED TO BE A LINEAR FUNCTION. OPERATING COSTS AND REPAYMENT OF INITIAL INVESTMENT WOULD BE COVERED BY THE FEES CHARGED FOR INSPECTION. REPAIR COSTS TO THE INDIVIDUAL MAY BE OFFSET BY IMPROVED FUEL ECONOMY. TABULATED DATA SHOW THE EFFECTIVENESS OF THE PROGRAM IN REDUCING HYDROCARBONS AND CARBON MONOXIDE. WARRANTY COVERAGE IS PROVIDED TO MOTORISTS IN AREAS HAVING AN INSPECTION/MAINTENANCE PROGRAM. THERE ARE FIVE ALTERNATIVES FOR THE PROGRAM: IDLE MODE TEST CONDUCTED AT STATE INSPECTION STATIONS, AT STATIONS OPERATED BY A CONTRACTOR TO THE STATE, OR AT PRIVATELY OWNED SERVICE STATIONS AND GARAGES, AND LOADED MODE TEST CONDUCTED AT STATE INSPECTION STATIONS, OR AT STATIONS OPERATED BY A CONTRACTOR TO THE STATE. THE NATURE OF THE EMISSIONS TEST, THE WAY IN WHICH THE TEST IS ADMINISTERED, THE INSTRUMENTATION, AND MAINTENANCE REQUIREMENTS ARE CONSIDERED, AS ARE THE SPECIAL NEEDS OF HEAVY DUTY VEHICLES AND THE EFFECTS ON THE REPAIR INDUSTRY. LEGISLATION NEEDS TO BE DEVELOPED TO DEAL WITH THE LEGAL AUTHORITY TO IMPLEMENT AN INSPECTION/MAINTENANCE PROGRAM. THE MAJOR PROBLEMS OF THE PROGRAM INCLUDE QUALITY CONTROL OF PRIVATE GARAGES, ADEQUACY OF THE REPAIR INDUSTRY TO PERFORM EMISSIONS-RELATED WORK, COMBINED SAFETY AND EMISSIONS TESTING, AND IMPACT OF WAIVING REPAIR REQUIREMENTS FOR CERTAIN VEHICLES. FACT SHEETS ARE PRESENTED ON EXISTING PROGRAMS; DATA ARE CURRENT AS OF SEP 1977.

by BENJAMIN F. KINCANNON; ALAN H. CASTALINE  
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BEDFORD, MASS. 01730  
68-01-4458  
Rept. No. GCA-TR-77-14-G(A); EPA-400/9-78-001; 1978; 107P  
179REFS  
Availability: NTIS

HS-022 905

### **MOTORCYCLE SAFETY AT NAVAL SUBMARINE SUPPORT FACILITY, SAN DIEGO**

THE NAVAL SUBMARINE SUPPORT FACILITY AT SAN DIEGO, CALIF., SET UP A MOTORCYCLE DRIVING TRAINING PROGRAM MODELED ON THAT OF THE MOTORCYCLE SAFETY FOUNDATION. GRADUATION FROM THE COURSE HAS NOW BECOME A REQUIREMENT FOR RIDING MOTORCYCLES ON BASE. OTHER SAFETY REGULATIONS FOR MOTORCYCLES ON BASE INCLUDE WEARING OF PROPER GARMENTS AND INSPECTION OF THE VEHICLE. MOTORSCOOTERS AND

MOTOR-DRIVEN CYCLES ARE SUBJECT TO THE SAME REGULATIONS.

by P. G. DIX  
Publ: FATHOM V9 N4 PL-3 (SPRING 1978)  
1978  
Availability: SEE PUBLICATION

HS-022 906

### **EFFECTS OF TAPER LENGTH ON TRAFFIC OPERATIONS IN CONSTRUCTION ZONES. FINAL REPORT**

THE EFFECT ON SAFETY OF BOTH STANDARD AND PROPOSED TAPER LENGTHS IN CONSTRUCTION ZONES WAS TESTED IN FIELD STUDIES WHICH MEASURED VEHICLE SPEEDS, TRAFFIC CONFLICTS, ERRATIC MANEUVERS, AND LANE ENCROACHMENTS AT FOUR SITES WITH DESIGN SPEEDS RANGING FROM 15 TO 45 MPH. THE PROPOSED TAPER LENGTH FORMULA YIELDS SHORTER TAPERS AT DESIGN SPEEDS BELOW 60 MPH THAN THE EXISTING FORMULA. HOWEVER, THE TESTS DID NOT IMPLICATE THE PROPOSED TAPER LENGTHS AS BEING MORE HAZARDOUS. ERRATIC-MANEUVER AND SLOW-MOVING CONFLICTS RATES WERE NEVER GREATER WITH THE PROPOSED TAPER THAN WITH THE STANDARD OR EXISTING TAPER. THERE WAS NO INDICATION THAT THE PROPOSED TAPER LENGTHS RESULTED IN A GREATER NUMBER OF PASSING VEHICLE OR TRUCK ENCROACHMENTS ON ADJACENT LANES.

by JERRY L. GRAHAM; MICHAEL C. SHARP  
MIDWEST RES. INST., 425 VOLKER BLVD., KANSAS CITY, MO. 64110  
DOT-FH-11-8121  
Rept. No. FHWA-RD-77-162; 1977; 46P 4REFS  
REPT. FOR MAY-DEC 1977.  
Availability: NTIS

HS-022 907

### **AFTER THE CRASH**

PROPER BEHAVIOR FOLLOWING A COLLISION INCLUDES STOPPING, WARNING ONCOMING TRAFFIC OF THE SITUATION, SEEKING OR GIVING FIRST AID, CALLING THE PROPER LAW ENFORCEMENT AGENCY, AND THEN EXCHANGING SUCH INFORMATION AS NAME, LICENSE NUMBERS, TELEPHONE NUMBERS, AND NAMES OF INSURANCE COMPANIES. IT IS NOT PROPER TO DISCUSS THE ACCIDENT OR OPINIONS ABOUT WHO WAS AT FAULT WITH ANYONE OTHER THAN THE POLICE; STAY CALM AND KEEP TO THE FACTS. GATHER INFORMATION ON THE OTHER DRIVER OR DRIVERS INVOLVED, THE OTHER VEHICLE OR VEHICLES INVOLVED, THE INJURED PEOPLE, THE WITNESSES, THE POLICE OFFICERS, AND SUCH DETAILS AS THE LOCATION OF THE ACCIDENT, DATE AND TIME, AND WEATHER AND HIGHWAY CONDITIONS. DIAGRAM THE ACCIDENT SITE AND THE MOVEMENT OF THE VEHICLES INVOLVED.

Publ: DRIVER V11 N10 P14-7 (MAR 1978)  
1978  
Availability: SEE PUBLICATION

HS-803 262

**EVALUATION OF ROLLOVER PROCEDURES - 45-DEGREE DOLLY ROLLOVERS. FINAL REPORT**

A ROLLOVER TEST PROCEDURE WAS DEVELOPED IN WHICH THE VEHICLE WAS ORIENTED AT 45° TO ITS LINE OF TRAVEL IN ORDER TO PROVIDE THE LONGITUDINAL VELOCITY OF REAL-WORLD HIGHWAY ROLLOVER CRASHES. FOUR PRELIMINARY TESTS WERE CONDUCTED IN ACCORDANCE WITH THE CURRENT FEDERAL MOTOR VEHICLE SAFETY STANDARDS (FMVSS) 208 PROCEDURE. THREE 1972 VEGA HATCHBACKS AND ONE 1971 VEGA NOTCHBACK WERE USED IN THESE TESTS. FIVE 45° TESTS WERE CONDUCTED USING 1972 CHEVROLET VEGA HATCHBACKS. THE TEST VEHICLES WERE INSTRUMENTED WITH LINEAR ACCELEROMETERS AND ROLL-RATE, PITCH-RATE, AND YAW-RATE MEASURING DEVICES. EACH VEHICLE CONTAINED TWO TEST DUMMIES, IN THE RIGHT FRONT AND RIGHT REAR SEATING POSITIONS, INSTRUMENTED WITH HEAD AND CHEST TRIAXIAL ACCELEROMETERS. MOMENT-OF-INERTIA VALUES WERE DETERMINED FOR ONE OF THE TEST VEHICLES. VERTICAL AND LATERAL SUSPENSION FORCE/DEFLECTION CHARACTERISTICS WERE MEASURED FOR ALL FIVE VEHICLES. ALTHOUGH THE TEST CONDITIONS IN THE 45° TESTS WERE CONTROLLED AS CLOSELY AS POSSIBLE (TEST SPEEDS RANGED FROM 29.5 TO 29.7 MPH AND VEHICLE WEIGHTS RANGED FROM 2893 TO 2900 POUNDS), THE VEHICLES DID NOT EXHIBIT IDENTICAL ROLL CHARACTERISTICS, ROLLING BETWEEN ONE HALF AND ONE AND A HALF TIMES.

by R. GRIFFIN; E. ENSERINK  
DYNAMIC SCIENCE, INC., 1850 W. PINNACLE PEAK RD., PHOENIX, ARIZ. 85047  
DOT-HS-6-01427  
1977; 323P  
REPT. FOR OCT 1976-JUL 1977.  
Availability: NTIS

HS-803 270

**RESTRAINT SYSTEM/SPEED LIMIT PUBLIC INFORMATION MATERIALS CATALOG. NUMBER 1**

THE COLLECTION IS INTENDED AS AN AID IN THE DESIGN OF PUBLIC EDUCATION PROGRAMS IN THE SUBJECT AREAS, AS WELL AS A RESOURCE FOR PERSONS INVOLVED IN GENERAL HIGHWAY SAFETY/PUBLIC INFORMATION ACTIVITIES. THE MATERIAL IS DIVIDED INTO SECTIONS ON RESTRAINT SYSTEMS AND SPEED LIMIT, WITH SUBDIVISIONS FOR BOTH ARTICLES AND REPORTS AND FOR PROMOTIONAL MATERIAL. PROMOTIONAL MATERIALS ARE ARRANGED BY SPONSORING ORGANIZATION AND ARE INDEXED UNDER BROAD SUBJECT HEADINGS. ARTICLES AND REPORTS ARE ARRANGED BY TITLE AND INDEXED BY ORGANIZATION AND AUTHOR.

by ANN C. GRIMM, COMP.  
UNIVERSITY OF MICHIGAN, HWY. SAFETY RES. INST., HURON PKWY. AND BAXTER RD., ANN ARBOR, MICH. 48109  
NHTSA-7-3371  
Rept. No. UM-HSRI-78-6; 1978; 50P REFS  
Availability: NTIS

HS-803 295

**ANNOTATED BIBLIOGRAPHY ON HIGHWAY TRAVEL EXPOSURE RESEARCH METHODS. BACKGROUND REVIEW**

EIGHTY-SEVEN ENTRIES RELATE TO ISSUES, METHODS, AND RESULTS OF RESEARCH CONCERNED WITH THE MEASUREMENT OF HIGHWAY TRAVEL EXPOSURE TO THE RISK OF ACCIDENT, MANY FOCUSING SPECIFICALLY ON THE MEASUREMENT OF VEHICLE MILES TRAVELED AS THE DENOMINATOR IN THE CALCULATION OF ACCIDENT RATES FOR DIFFERENT CATEGORIES OF DRIVER, VEHICLE, AND ENVIRONMENTAL CHARACTERISTICS. INCLUDED ARE STUDIES WHICH MAKE USE OF EXISTING PUBLIC RECORD DATA, STUDIES WHICH OBTAIN DATA BY ROADSIDE COUNTING, ROADSIDE OBSERVATION, AND ROADSIDE INTERVIEW, AND STUDIES WHICH OBTAIN DATA BY HOME AND LICENSING OFFICE INTERVIEWS AND QUESTIONNAIRES (USING IN-PERSON, TELEPHONE, AND MAIL TECHNIQUES).

by ARTHUR C. WOLFE  
UNIVERSITY OF MICHIGAN, HWY. SAFETY RES. INST., ANN ARBOR, MICH. 48109  
DOT-HS-7-01685  
Rept. No. UM-HSRI-78-7; 1978; 48P  
REPT. FOR 1 AUG 1977-31 JAN 1978.  
Availability: NTIS

HS-803 299

**AN ANALYSIS OF ASAP PATROL ACTIVITY [ALCOHOL SAFETY ACTION PROJECT]**

A DESCRIPTION, EVALUATION, AND DISCUSSION ARE PRESENTED OF VERMONT'S PROJECT CRASH (COUNTERMEASURES RELATED TO ALCOHOL SAFETY ON THE HIGHWAYS) UNDER WHICH STATE TROOPERS SERVED AT LEAST THREE MONTHS IN AN INTENSIFIED ENFORCEMENT TEAM WHICH PATROLLED AT TIMES AND LOCATIONS OF HIGH INCIDENCE OF DRINKING AND DRIVING. EACH TROOPER WAS TRAINED IN THE USE OF THE TAPE RECORDERS, MOBILE PROCESSING UNIT, AND THE CRIMPER SAMPLE GATHERING DEVICE, AS WELL AS IN THE PROCESSING FORMS FOR A DRIVING WHILE INTOXICATED (DWI) CITATION, AND STANDARD OPERATING PROCEDURES. THE MOBILE PROCESSING CENTER WAS EQUIPPED WITH A PHOTO-ELECTRIC INTOXIMETER, SUBSEQUENTLY REPLACED BY A GAS CHROMATOGRAPH, AND A VIDEO TAPE RECORDER. EACH TROOPER USED A HAND-HELD TAPE RECORDER FOR RECORDING AN ENTIRE ARREST, FROM THE FIRST APPEARANCE OF THE SUSPECTED PERSON UNTIL HE LEFT THE OFFICER. AS A RESULT OF THE CRASH PROJECT, THE CONVICTION RATE FOR DWI IS INCREASING, THERE IS A SMALL DECREASE IN ALCOHOL/RELATED FATALITIES AND CRASHES, AND THE DRIVING PUBLIC IS AWARE THAT THERE IS A HIGH PROBABILITY OF ARREST FOR DWI. THERE WAS NO APPARENT DETERRENT EFFECT ON ALCOHOL IMPAIRED DRIVING SINCE ARRESTS FOR DWI ARE INCREASING. IT IS NOW BELIEVED THAT AN ALCOHOL IMPAIRED PERSON CANNOT BE DETERRED FROM DRIVING. THE



ONLY SOLUTION RESTS IN PREVENTING ALCOHOL IMPAIRMENT, ESTIMATED AT A BLOOD ALCOHOL CONCENTRATION OF 0.08%. VISUAL CLUES ARE NOT AN ACCURATE MEASURE OF IMPAIRMENT. LONG RANGE PROGRAMS OF EDUCATION, ENFORCEMENT, AND THERAPY ARE ENVISIONED BEFORE DWI CAN CEASE TO BE A PROBLEM.

VERMONT DEPT. OF MENTAL HEALTH, PROJ. CRASH, WATERBURY, VT.

FH-11-7543

Rept. No. KEY-ANALYTIC-STUDY-3; 1974; 135P  
INCLUDES HS-803 300--HS-803 304.

Availability: REFERENCE COPY ONLY

HS-803 300

### **OFFICERS' MANUAL ON THE USE, ABUSE AND DETECTION OF ALCOHOL**

THIS MANUAL FOR USE BY VERMONT'S LAW ENFORCEMENT PERSONNEL IS INTENDED TO HELP THEM DETECT, APPREHEND, AND PROCESS PERSONS OPERATING MOTOR VEHICLES WHILE UNDER THE INFLUENCE OF INTOXICATING LIQUORS (DWI). INCLUDED ARE THE FOLLOWING SECTIONS: A TEST OF THE READER'S KNOWLEDGE ABOUT ALCOHOL; A DISCUSSION OF THE SERIOUSNESS OF THE DWI PROBLEM AND OF WHAT CAN BE DONE ABOUT IT; VERMONT'S DWI LAWS; AND A DISCUSSION OF ALCOHOL AND ITS EFFECTS ON THE BODY. ALSO INCLUDED ARE MYTHS ABOUT DRINKING, A DESCRIPTION OF ALCOHOLISM AND SOURCES OF HELP FOR PERSONS WHO HAVE DRINKING PROBLEMS. OTHER CHAPTERS INCLUDE THE FOLLOWING MATERIAL: WHO IS THE DWI; DRUNK VERSUS IMPAIRED DRIVING; PATROL TIPS FOR DWI DETECTION; AND HOW TO RECOGNIZE THE DRUNK DRIVERS. SUGGESTIONS ARE GIVEN FOR HANDLING PERSONS SUSPECTED OF OPERATING DWI, AND FOR PROCESSING DWI'S. CRIMPER INSTRUCTIONS ARE GIVEN, AS ARE PROCEDURES FOR USING AN AUDIO TAPE RECORDER.

VERMONT DEPT. OF MENTAL HEALTH, PROJECT CRASH, WATERBURY, VT.

FH-11-7543

1974?; 77P

Availability: IN HS-803 299

HS-803 301

### **KNOWLEDGE AND ATTITUDES OF POLICE OFFICERS ABOUT ALCOHOL AND HIGHWAY SAFETY BEFORE AND AFTER INVOLVEMENT IN A COUNTERMEASURE PROGRAM**

VERMONT POLICE OFFICERS WERE QUESTIONED TO LEARN THEIR REACTIONS TO THEIR AFFILIATION WITH PROJ. CRASH (COUNTERMEASURES RELATED TO ALCOHOL SAFETY ON THE HIGHWAYS), BOTH IN KNOWLEDGE ABOUT DRIVING WHILE INTOXICATED (DWI) AND IN THEIR ATTITUDES. THERE WAS NO CHANGE OVER TIME IN THE OFFICER'S KNOWLEDGE OF THE PHYSIOLOGY OF ALCOHOL OR THE ROLE OF ALCOHOL IN CRASHES, AND NO CHANGE IN ATTITUDES TOWARD PROBLEM DRINK-

ING. OFFICERS DID BECOME MORE DILIGENT AND PROFICIENT IN IDENTIFYING AND APPREHENDING DWI'S AND BECAME MORE SUPPORTIVE OF BETTER RECORDKEEPING SYSTEMS CONCERNING ALCOHOL-RELATED CRASHES, OFFENSES, AND PROBLEMS. THE OFFICERS BECAME MORE WILLING TO HAVE PERSONS HAVING SUSPENDED LICENSES BECAUSE OF DWI CONVICTIONS PERMITTED TO DRIVE TO AND FROM THEIR JOBS, PERHAPS WITH SPECIAL LICENSE PLATES.

by JULIAN A. WALLER; TAKA ASHIKAGA  
VERMONT DEPT. OF MENTAL HEALTH, PROJ. CRASH, WATERBURY, VT.

FH-11-7543

Rept. No. CRASH-3-5; 1974; 15P

Availability: IN HS-803 299

HS-803 302

### **DETERMINING STRATEGIES AND EXPECTATIONS REGARDING INCREASED ENFORCEMENT AGAINST ALCOHOL IMPAIRED DRIVING IN RURAL AREAS**

ALCOHOL SAFETY ACTION PROJECTS IN RURAL AREAS, SUCH AS VERMONT'S PROJ. CRASH (COUNTERMEASURES RELATED TO ALCOHOL SAFETY ON THE HIGHWAYS), SHOULD CONCENTRATE ON DETERRENCE RATHER THAN ON ARRESTS, SINCE SUFFICIENT SPECIAL DETECTION PATROLS IN RURAL AREAS ARE NOT COST EFFECTIVE. THERE SHOULD BE WIDE AND CONTINUING NEWSPAPER AND RADIO AND OTHER PUBLICITY ABOUT ONGOING ENFORCEMENT ACTIVITIES AND ABOUT THE NUMBERS OF PERSONS CAUGHT. THERE SHOULD BE A MOBILE POLICE FORCE WHICH GETS HIGH VISIBILITY WITH VERY FEW OFFICERS BY BEING SEEN DRIVING AT HIGH-RISK TIMES AND PLACES; FOR EXAMPLE, FRIDAY AND SATURDAY NIGHT SHIFTS COULD BE ESTABLISHED FROM 9 P.M. TO 2 A.M., WITH A SMALLER CADRE ON DUTY FROM 2 A.M. TO 4 A.M. A SPRINKLING OF HIGHLY VISIBLE OFFICERS SHOULD BE AVAILABLE ALSO AT SOMEWHAT LOWER DRINKING TIMES SUCH AS 9 P.M. TO 2 A.M. ON WEEKNIGHTS. THE OFFICER SHOULD BE AWARE THAT ONLY A VERY FEW OF THE PERSONS DRIVING WHILE ALCOHOL-IMPAIRED CAN BE IDENTIFIED AND ARRESTED. SINCE EVIDENCE SHOWS THAT THE HEAVIER DRINKERS ARE THE MORE LIKELY TO RECIDIVATE, ENFORCEMENT PROGRAMS MUST BE COUPLED WITH REHABILITATION PROGRAMS.

by JULIAN A. WALLER  
VERMONT DEPT. OF MENTAL HEALTH, PROJ. CRASH, WATERBURY, VT.

FH-11-7543

Rept. No. CRASH-3-3; 1973; 11P

Availability: IN HS-803 299

HS-803 303

# **THE USE OF VIDEO TAPE IN DWI [DRIVING WHILE INTOXICATED] ENFORCEMENT IN THE STATE OF VERMONT**

VERMONT'S ALCOHOL SAFETY ACTION PROJ. KNOWN AS PROJ. CRASH (COUNTERMEASURES RELATED TO ALCOHOL SAFETY ON THE HIGHWAYS) TRIED USING VIDEOTAPE MACHINES TO INCREASE THE RATE OF CONVICTION FOR DRIVING WHILE INTOXICATED. AFTER ONE YEAR, THE USE OF VIDEOTAPE WAS DETERMINED TO BE OF NO ADVANTAGE AND IN FACT TO BE COSTLY IN TERMS OF EQUIPMENT AND MANPOWER. VIDEOTAPE EVIDENCE WAS ADMITTED INTO COURT AS EVIDENCE ONLY ONCE. PROBLEMS INCLUDED THE NECESSITY OF SETTING UP ARTIFICIAL ILLUMINATION, SINCE MOST ARRESTS TOOK PLACE AFTER DARK, AND SUCH A PROCEDURE IS HAZARDOUS ON THE TYPICAL TWO-LANE VERMONT ROAD. ATTEMPTS TO BRING DWI SUSPECTS TO A CENTRALLY LOCATED VIDEOTAPE MACHINE WERE ALSO UNSATISFACTORY; LONG DISTANCES HAD TO BE COVERED AND THIS CONSIDERABLY LENGTHENED PROCESSING TIME. ALSO, SOME PERSONS WHO ARE ALCOHOL-IMPAIRED MAY NOT APPEAR PARTICULARLY DRUNK TO A JURY. THE USE OF AN AUDIOTAPE, HOWEVER, HAS PROVED VERY HELPFUL. IT IS EASY TO USE BY THE SINGLE PATROL OFFICER, IS INEXPENSIVE, HAS BEEN ADMITTED INTO COURT AS EVIDENCE, AND IS EASY TO MAIL, DELIVER, AND PLAY.

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WATERBURY, VT.  
FH-11-7543  
Rept. No. CRASH-3-2; 1972; 7P  
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HS-803 304

# **THE USE OF AUDIO TAPE RECORDING IN DWI [DRIVING WHILE INTOXICATED] ENFORCEMENT**

OFFICERS OF VERMONT'S ALCOHOL SAFETY ACTION PROJ. KNOWN AS PROJ. CRASH (COUNTERMEASURES RELATED TO ALCOHOL SAFETY ON THE HIGHWAYS) BEGAN USING AUDIOTAPE RECORDERS IN AUG 1971 WHEN APPREHENDING PERSONS SUSPECTED OF DRIVING WHILE INTOXICATED (DWI), WITH CONSIDERABLE SUCCESS. THE RECORDINGS ARE ACCEPTED INTO COURT AS EVIDENCE, THEY AVOID THE NECESSITY OF RECONSTRUCTING EVENTS, THEY HELP IN TRAINING, AND THEY ARE EASY AND INEXPENSIVE FOR THE PATROL OFFICER TO USE. THE OFFICER STARTS THE RECORDING AS SOON AS HE OR SHE SPOTS A SUSPICIOUS DRIVER, AND CONTINUES THE RECORDING DURING THE ENTIRE PROCESSING TIME.

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# **EFFECTS OF INCREASED POLICE ACTIVITY AT HIGH ALCOHOL TIMES ON BREATH ALCOHOL CONCENTRATIONS OF DRIVERS AND PASSENGERS - 1974 SURVEY**

BLOOD ALCOHOL CONCENTRATIONS (BAC'S) OF VERMONT DRIVERS OBTAINED IN ROADSIDE SURVEYS AT TIMES AND PLACES OF HIGH ALCOHOL USE WERE COMPARED IN A GEOGRAPHIC AREA WITH INCREASED POLICE PATROLS AS A PART OF PROJ. CRASH (COUNTERMEASURES RELATED TO ALCOHOL SAFETY ON THE HIGHWAYS) AND IN AN AREA WITHOUT SUCH ENFORCEMENT. DATA WERE GATHERED DURING A BASELINE PERIOD AND DURING TWO SUBSEQUENT FOLLOW-UP PERIODS. IN THE ENFORCEMENT AREA THERE WAS AN INITIAL 27% DECREASE FROM BASELINE IN DRIVERS WITH BAC'S OF 50 MG% OR HIGHER, BUT THIS PERCENTAGE RETURNED TO BASELINE LEVELS IN THE SECOND FOLLOW-UP PERIOD. IN THE COMPARISON AREA DURING THE BASELINE PERIOD, THE PROPORTION OF PERSONS WITH HIGH BAC'S WAS THE SAME AS IN THE ENFORCEMENT AREA. THIS DID NOT DECREASE DURING THE FIRST FOLLOW-UP PERIOD, AND BECAME EVEN GREATER DURING THE SECOND SUCH PERIOD. THUS, DURING BOTH FOLLOW-UP PERIODS THE COMPARISON AREA HAD HIGHER PROPORTIONS OF DRIVERS WITH HIGH BAC'S. DURING THE SECOND FOLLOW-UP PERIOD, THIS DIFFERENCE WAS NOT SIGNIFICANT, BUT DATA FROM ANOTHER ROADBLOCK SURVEY HELD DURING THE SECOND FOLLOW-UP PERIOD SUGGEST THAT THE DIFFERENCES BETWEEN THE ENFORCEMENT AND COMPARISON AREA WERE NOT DUE TO CHANCE.

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ALAN M. VOORHEES AND ASSOCIATES, INC., MCLEAN, VA.; KLD ASSOCIATES, INC., HUNTINGTON STATION, N.Y.

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UNIVERSITY OF MICHIGAN, HWY. SAFETY RES. INST., HURON PKWY. AND BAXTER RD., ANN ARBOR, MICH. 48109

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UNIVERSITY OF KANSAS, CENTER FOR RES., INC., LAWRENCE, KANS.

HS-022 789

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GCA CORP., TECHNOLOGY DIV., BURLINGTON RD.,  
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OLSON LABS., INC., 421 E. CERRITOS AVE.,  
ANAHEIM, CALIF. 92805

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**73.089**  
CALIFORNIA DEPT. OF MOTOR VEHICLES, RES.  
AND DEVEL. SECTION, SACRAMENTO, CALIF. 95809  
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